Essentials of NURSING INFORMATICS

STUDY GUIDE

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McGraw Hill Education

Essentials of Nursing Informatics Study Guide

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PREFACE

Essentials of Nursing Informatics Study Guide has been created for the educator as a resource to facilitate and enhance teaching nursing informatics. Based on the 6th Edition of Saba and McCormick's *Essentials of Nursing Informatics*, each chapter has been outlined in an easy to understand format for the educator to convey to students the latest concepts, technologies, policies, and skills. Also available to the nurse educator are teaching tips, class preparation ideas, learning objectives, review questions, and answer explanations to supplement the 6th Edition of *Essentials of Nursing Informatics.* The Study Guide also includes an online faculty resource to supplement classroom teaching (available at EssentialsofNursingInformatics.com), which includes chapter outlines, learning objectives, key words, and explanatory illustrations and tables. These features frees the faculty to spend more time teaching and less in organizing content. The guide is invaluable to students for self-study and review of nursing informatics.

Essentials of Nursing Informatics Study Guide is systematically organized into nine sections encompassing all areas of nursing informatics theory and practice:

- Nursing Informatics Technologies
- System Life Cycle
- Informatics Theory Standards/Foundations of Nursing Informatics
- Nursing Informatics Leadership
- Advanced Nursing Informatics in Practice
- Nursing Informatics/Complex Applications
- Educational Applications
- Research Applications
- Big Data Initiatives

In this first edition, the goal has been to close the gap that exists in teaching and understanding the breadth of areas in nursing informatics for educators and students. The ultimate goal is to increase the number of registered nurses prepared in nursing informatics to improve the quality, safety, efficiency, and effectiveness in healthcare.

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PART 1

Nursing Informatics Technologies

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1

Historical Perspective of Nursing Informatics

• OBJECTIVES

1. Describe the historical perspective of nursing informatics.
2. Explore lessons learned from the pioneers in nursing informatics.
3. Describe the types of nursing standards initiatives.
4. Review the historical perspectives of electronic health records.
5. List the major landmark events and milestones of nursing informatics.

• KEY WORDS

Computers
Computer literacy
Computer systems
Data standards
Electronic health records (EHR)
Healthcare information technology (HIT)
Information systems
Internet
Nursing informatics

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of how nurses might use computers in patient care? Can you give examples of why it is important to use computers in patient care? When were computers first introduced into the healthcare environment? When do you think nurses began using computers? Why is it important for nurses to learn about the history of nursing informatics? Why is it important to learn more about the pioneers in nursing informatics? Do you know a nurse that works in an informatics department? Describe his/her role and responsibilities as a nurse informatician.

For a WIIFM statement, say to the class, "It is important to learn about the significant events influencing the growth of nursing informatics as a nursing specialty. In this chapter, the significant events influencing the growth of nursing informatics are analyzed according to: (1) Seven Time Periods; (2) a synthesis of lessons learned from 33 videotaped interviews with Nursing Informatics Pioneers; (3) Nursing Standards Initiatives including nursing practice and education, nursing content standards, and confidentiality and security standards; (4) Electronic Health Records from a Historical Perspective; and (5) Landmark Events in Nursing and Computers including those events that influenced the introduction of computers into the nursing profession including key "computer/informatics" nurse(s) that directed the activity. As a nurse, it is important to understand the historical perspectives of nursing informatics.

Class Preparation

1. Review the references listed at the end of the textbook chapter
2. Review the AMIA History Project website, the videos, and text transcripts
3. Review American Association of Colleges of Nursing and the essentials related to nursing informatics

Timing

1. Lecture

PRETEST

1. No pretest for this chapter

OVERVIEW

Nursing Informatics

1. Evolved from the French word "informatics"
2. Referred to the field of applied computer science
3. Concerned with the processing of information such as nursing information

Computers

1. First introduced into healthcare facilities in the 1960s
2. For the processing of basic administrative tasks
3. The computer is an essential tool in HITsystems

Health Information Technology (HIT)

1. HIT is an all-encompassing term
2. Refers to technology that
    a. Captures health information
    b. Processes health information
    c. Generates health information
3. Computerization affects all aspects of healthcare delivery including
    a. Provision and documentation of patient care
    b. Education of healthcare providers
    c. Scientific research for advancing healthcare delivery
    d. Administration of healthcare delivery services
    e. Reimbursement for patient care
    f. Legal and ethical implications
    g. Safety and quality issues
4. A shift toward
    a. Integrating multiple technologies and telecommunication devices
    b. Invisible storage devices such as cloud storage
    c. User-friendly, menu-driven, touchscreen manipulation methods
5. Computers in nursing are used for
    a. Managing patient care information
    b. Monitoring quality
    c. Evaluating outcomes
    d. Communicating data and messaged via the Internet
    e. Accessing resources
    f. Interacting with patients on the Web
    g. Documenting and processing real-time plans of care
    h. Supporting nursing research
    i. Testing new systems
    j. Designing new knowledge databases
    k. Developing data warehouses
    l. Advancing the role of nursing in the healthcare industry and nursing science

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for students to ask questions.

MAJOR HISTORICAL PERSPECTIVES OF NURSING AND COMPUTERS

Seven Time Periods

1. Prior to the 1960s
    a. Developed in the late 1930s and early 1940s
    b. Use in healthcare did not begin until the 1950s and 1960s
    c. A few experts formed a cadre to adapt computers to healthcare and nursing
    d. Computers in healthcare were used for administrative and accounting functions
2. 1960s
    a. Use of computer technology began to be explored
    b. Studies were conducted to determine how computer technology could be utilized
    c. The nurses' station was viewed as the most appropriate center for the development of computer applications
    d. The mid-1960s presented nurses with new opportunities for computer use
    e. Increased time devoted to documentation and a rise in medication errors prompted the investigation of emerging computer-based information systems
3. 1970s
    a. During the late 1960s through the 1970s, hospitals began developing computer-based information systems which initially focused on
        (1) Physician order entry
        (2) Results reporting
        (3) Pharmacy
        (4) Laboratory
        (5) Radiology reports
        (6) Information for financial and managerial purposes
        (7) Physiologic monitoring systems in the intensive care units
    b. A few systems started to include
        (1) Care planning
        (2) Decision support
        (3) Interdisciplinary problem lists
    c. Nurses were often involved in implementing systems
    d. Interest in computers and nursing began to emerge in public and home health and education

- **e.** In the 1970s, conferences helped public and home health nurses
  - **(1)** Understand the importance of nursing data and their relationship to new Medicare and Medicaid legislation
  - **(2)** Provide information on the usefulness of computers for capturing and aggregating home health and public health information
- **f.** Hospitals and public health agencies embarked on investigating computers and nursing
- **g.** The opportunity to improve education using computer technology also began
- **h.** Early nursing networks helped to expand nursing awareness of computers and the impact HIT could have on practice
- **i.** The Clinical Center at the National Institutes of Health implemented the Technicon Medical Information System (TDS) computer system
- **j.** TDS one of the earliest clinical information systems (called Eclipsys & Allscripts)
- **k.** TDS was the first system to include nursing practice protocols

4. 1980s

- **a.** The field of nursing informatics exploded and became visible in the healthcare and nursing
- **b.** The nursing profession needed to update its practice standards and determine its data standards, vocabularies, and classification schemes that could be used for the computer-based patient record systems
- **c.** Many mainframe healthcare information systems (HISs) emerged with nursing subsystems
- **d.** These systems documented several aspects of the patient record
- **e.** The microcomputer or personal computer (PC) emerged during this period
- **f.** The first Nursing Special Interest Group on Computers met for the first time during SCAMC (Symposium on Computer Applications in Medical Care) in 1981
- **g.** In 1985, the ANA approved the formation of the Council on Computer Applications in Nursing (CCAN)
- **h.** CCAN became a very powerful force in integrating computer applications into the nursing profession
- **i.** The first edition of this book published in 1986

5. 1990s

- **a.** Advances in relational databases, client-server architectures, and new programming methods
- **b.** Better application development at lower costs
- **c.** Legislative activity in the mid-1990s paved the way for electronic health records through the Health Insurance Portability and Accountability Act (HIPAA) of 1996 (public-law 104-19)
- **d.** The complexity of technology, workflow analysis, and regulations shaped new roles in nursing
- **e.** In 1992, the ANA recognized nursing informatics as a new nursing specialty separate *Scope of Nursing Informatics Practice Standards*, and also established a specific credentialing examination for it
- **f.** The demand for nursing informatics (NI) expertise increased
- **g.** The ANA developed the *Nursing Information and Data Set Evaluation Standards* (NIDSEC) to evaluate and recognize nursing technology rapidly changed in the 1990s
  - **(1)** PCs became smaller
  - **(2)** Computer notebooks became affordable
  - **(3)** Computers were linked through networks
  - **(4)** The Internet became mainstream
  - **(5)** The World Wide Web (WWW) increased access to information
- **h.** The purpose of Information systems was to guide the development and selection of nursing systems that included standardized nursing terminologies integrated throughout the system

6. 2000s

- **a.** More healthcare information became digitalized and newer technologies emerged
- **b.** In 2004 an Executive Order 13335
  - **(1)** Established the Office of the National Coordinator (ONC) for Healthcare Information Technology (HIT)
  - **(2)** Issued a recommendation calling for all healthcare providers to adopt interoperable electronic health records (EHRs) by 2014/2015
- **c.** Wireless, point of care, regional database projects, and increased IT solutions proliferated
- **d.** The use of bar coding and radio-frequency identification (RFID) emerged as a useful technology
- **e.** Smaller mobile devices with wireless or Internet access increased access to information for nurses within hospitals and in the community
- **f.** The development and refinement of voice over Internet protocol (VoIP) provided voice cost-effective communication
- **g.** The Internet provided a means for development of clinical applications
- **h.** The nursing informatics research agenda promoted the integration of nursing care data in HIT systems that would also generate data for analysis, reuse, and aggregation

7. 2010s

- **a.** The impact of the Nursing Minimum Data Set (NMDS) demonstrated that continued consensus and effort was needed to bring to fruition the vision and implementation of minimum nursing data into clinical practice
- **b.** A new nursing informatics research agenda for 2008–2018 emerged as critical for this specialty
- **c.** The new agenda is built on one originally developed and published by the National Institute for Nursing Research (NINR) in 1993
- **d.** During 2010, the ONC convened two national committees:
  - **(1)** National Committee on Health Policy
  - **(2)** National Committee on Health Standards which outlined and designed the focus for the “Meaningful Use” (MU) legislation

- **e.** Meaningful Use was designed to be implemented in at least three stages
- **f.** Consists of the regulations which built onto each other with the ultimate goal of implementing a complete an interoperable EHR and/or HIT system in all US hospitals
- **g.** In 2011/2012 MU Stage 1 was initiated focusing primarily on the Computerized Physician Order Entry (CPOE) initiative for physicians
- **h.** In 2012/2013 MU Stage 2 was introduced focusing primarily on the implementation of Quality Indicators
- **i.** The Quality Indicators are used to guide hospitals in patient safety and if not implemented used as indicators subject to financial penalties
- **j.** It is anticipated that MU Stage 3 will be implemented in 2014/2015
- **k.** The Center for Medicare and Medicaid Services (CMS) plans to increase reimbursement for the implementation of "MU" regulations in their HIT and/or EHR systems through 2015
- **l.** CMS may even penalize eligible providers and facilities who do not meet the proposed MU criteria
- **m.** As the MU requirements increase they will impact on the role of the NI experts in hospitals
- **n.** MU requirements ultimately on the roles of all nurses in the inpatient facilities, making NI an integral component of all professional nursing services

Consumer-centric Healthcare System

1. There is a shift to a consumer-centric healthcare system due to escalating costs
2. Consumers are encouraged to be active partners in their care
3. A variety of technologies have evolved to enable consumers to have access to their health information
4. Consumers can choose whether to share this across healthcare providers and settings
5. Personal health records multiplied as either stand-alone systems or those tethered to EHRs
6. Consumers are more literate regarding healthcare information literacy and expect to become more involved in managing their own health

Teaching Tip
Ask the students to compare and contrast the decades. Ask the students, which decade was most influential to nursing informatics Ask the students, which decade was most memorable. Why?

NURSING INFORMATICS PIONEERS

History Project

1. In 1995, Saba initiated a history of NI at the National Library of Medicine, which consisted of the collection of archival documents from the NI pioneers
2. The history project was initiated based on a recommendation by Dr. Morris Collen
3. In 2001, that the Nursing Informatics Working Group (NIWG) of the American Medical Informatics Association (AMIA) became involved
4. The NI History Committee was established to take on this project
5. The committee solicited archival material from the known NI pioneers for a History of Nursing Informatics to be housed in the NLM as part of its History Collection
6. In 2004, the rich stories of pioneers in nursing informatics were captured through a project sponsored by the AMIA-NIWG
7. Pioneers were defined as those who "opened up" a new area in nursing informatics and provided a sustained contribution to the specialty
8. Through multiple contacts and review of the literature, 145 pioneers and contributors were identified as having shaped nursing informatics since the 1950s
9. Each identified pioneer was contacted to submit their non-published documents and/or historical materials to the NLM to be indexed and archived for the Nursing Informatics History Collection
10. The catalogued document descriptions can be searched online: www.nlm.nih.gov/hmd/manuscripts/accessions.html
11. A convenience sample of pioneers was interviewed over a 4-year period at various nursing informatics meetings
12. Videotaped stories from 33 pioneers were recorded
13. The 33 videotaped stories are available on the AMIA website: www.amia.org/niwg-history-page
14. The website also provides "use cases" for ideas about how to use the information for teaching and learning more about the pioneers
15. These resources are particularly useful for courses in informatics, leadership, and research
16. They also are useful for nurses in the workforce who want to learn more about nursing informatics history
17. The early pioneers came from a variety of backgrounds as nursing education in nursing informatics didn't exist in the 1960s
18. Almost all of the pioneers were educated as nurses, though a few were not
19. The pioneers had a vision that technology could make nursing practice better
20. The nursing pioneers influenced the evolution of informatics as a specialty from granular-level data through health policy and funding

Teaching Tip
Ask the students to work in groups of 3–4 students. Assign each group to research a pioneer. Ask the students to report their findings back to the class.

NURSING STANDARDS INITIATIVES

Nursing Practice Standards

1. Nursing practice standards have been developed and recommended by the ANA

2. *Nursing Scope and Standards of Practice* that focused
    a. *On the organizing principles of clinical nursing practice*
    b. *The standards of professional performance*
3. *Nursing Informatics Scope and Standards of Practice* builds on
    a. Clinical practice standards
    b. Outlines further the importance for implementing standardized content to support nursing practice by specialists in nursing informatics

Nursing Education Standards

1. Since the NLN's *Nursing Forum on Computers in Healthcare and Nursing* was formed in 1985, it has supported the integration of computer technology in the nursing curriculum
2. The American Association of Colleges of Nursing (AACN), revised *The Essentials for Doctoral Education for Advanced Nursing Practice* and *The Essentials of Baccalaureate Education for Professional Nursing Practice* to require the use of computers and informatics for both baccalaureate and graduate education

Nursing Content Standards

1. The nursing process data elements in EHRs are essential for the exchange of nursing information across information systems and settings
2. Standardization of healthcare data began in 1893 with the *List of International Causes of Death* for the reporting of morbidity cases worldwide
3. The standardization of nursing began with Florence Nightingale's six cannons in her "Notes on Nursing"
4. In 1955, Virginia Henderson published her 14 Daily Patterns of Living as the list of activities and conditions that became the beginning of nursing practice standards in the United States
5. In 1970, the ANA accepted the Nursing Process as the professional standards for nursing practice and which was followed by the standardization of nursing content-data elements in 1973
6. Currently, the ANA has recognized 12 nursing terminologies
7. The ANA selected six of the ANA recognized nursing languages for inclusion in the NLM's Metathesaurus of the Unified Medical Language System (UMLS) and for inclusion in the Systematized Nomenclature of Medicine—Clinical Terms (SNOMED-CT)
8. There are a large number of standards organizations that impact healthcare data content as well as healthcare technology systems

Confidentiality and Security Standards

1. Increasing access through the electronic capture and exchange of information raised concerns about the privacy and security of personal healthcare information (PHI)
2. Provisions for strengthening the original HIPAA legislation were included in the 2009 HITECH Act

Teaching Tip

Ask the students to discuss why standards are important to nursing informatics.

ELECTRONIC HEALTH RECORDS FROM A HISTORICAL PERSPECTIVE

The Institute of Medicine (IOM)

1. In 1989, the Institute of Medicine (IOM) convened a committee and asked the question, "Why is healthcare still predominantly using paper-based records when so many new computer-based information technologies are emerging?"
2. Two major conclusions resulted from the committee's deliberations.
    a. First, computerized patient record (CPR) is an essential technology for healthcare and is an integral tool for all professionals
    b. Second, the committee after hearing from numerous stakeholders recognized that there was no national coordination or champion for CPRs

The Computer-Based Patient Record Institute

1. Created in 1992
2. Given the mission to initiate and coordinate the urgently needed activities to develop, deploy, and routinely use CPRs to achieve improved outcomes in healthcare quality, cost, and access
3. Developed the CPR Project Evaluation Criteria in 1993 modeled after the Baldridge Award
    a. These criteria formed the basis of a self-assessment that could be used by organizations and outside reviewers to measure and evaluate the accomplishments of CPR projects
    b. The four major areas of the initial criteria
        (1) Management
        (2) Functionality
        (3) Technology
        (4) Impact
    c. Provided a framework through which to view an implementation of computerized records
    d. The criteria which provided the foundation for the Nicholas E. Davies Award of Excellence Program
4. The Davies Program evolved through multiple revisions
5. Under HIMSS management, the Davies Award of Excellence is offered in four categories
    a. Enterprise (formerly Organizational or Acute Care), first offered in 1995
    b. Ambulatory Care, started in 2003
    c. Public Health, initiated in 2004
    d. Community Health Organizations (CHO), first presented in 2008

LANDMARK EVENTS IN NURSING AND COMPUTERS

Major Milestones

1. Computers were introduced into the nursing profession over 40 years ago
2. Major milestones of nursing are interwoven with the advancement of computer and information technologies
3. The increased need for nursing data, development of nursing applications, and changes, making the nursing profession an autonomous discipline
4. There are currently several key events in which the NI community participates
    a. Conferences
    b. Symposia
    c. Institutes
    d. Workshops
5. Key events provide
    a. An opportunity for nursing informatics novices and experts to network and share their experiences
    b. Key events provide the latest information, newest exhibits, and demonstrations

SUMMARY

Key takeaways to consider include the following

- Computers, and subsequently information technology, emerged during the past five decades in the healthcare industry
- Hospitals began to use computers as tools to update paper-based patient records
- Computer systems in healthcare settings provided the information management capabilities needed to
    - Assess
    - Document
    - Process
    - Communicate patient care
- The history of informatics from the perspective of the pioneers was described in this chapter
- Innumerable organizations sprang up in an attempt to
    - Set standards for nursing practice and education
    - Standardize the terminologies
    - Create standard structures for EHRs
    - Attempt to create uniformity for the electronic exchange of information
- The success of the conferences and the appearance of nursing literature demonstrated the intense interest nurses had in learning more about computers and information technologies.
- These advances confirmed the status of NI as a new ANA specialty in nursing
- Provided the stimulus to transform nursing in the 21st century

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the learning objectives

- Identify a brief historical perspective of nursing informatics
- Explore lessons learned from the pioneers in nursing informatics
- List the major landmark events and milestones of nursing informatics

Teaching Tip
Ask the students to define the keywords.

- Computers
- Computer literacy
- Computer systems
- Data standards
- Electronic health records (EHR)
- Healthcare information technology (HIT)
- Information systems
- Internet
- Nursing informatics

CHAPTER REVIEW QUESTIONS

Question 1.1: Which event was considered to be the first major computerized system(s) used for nursing practice in the 1970s?

a. Physiological Monitoring Systems in Hospital ICUs
b. Metathesaurus of the National Library of Medicine
c. PLATO designed to teach classes in off-campus sites
d. Army Nurse Corp conducted Educational Workshops

Question 1.2: Which event was a critical milestone for nursing and computers in the 1980s?

a. The Internet emerged for public use
b. Nursing Computer Conference at NIH
c. ANA approved the formation of the Council on Computer Applications in Nursing (CCAN)
d. Faye Abdellah's published 21 Problems for nursing practice

Question 1.3: Which event was a critical historical nursing and computer milestone in the 1990s?

a. Nurses presented papers at the first SCMC
b. ARRA legislation passed
c. ANA recognized Nursing Informatics as a new nursing specialty
d. Office of National Coordinator established

Question 1.4: Which event in the 2000s became a significant milestone for the promotion of HIT systems in the United States?

a. Bar Coding Technology emerged

b. RFID Technology emerged

c. ONC was established in 2004 and first ONC Coordinator named

d. MU Stage 1was initiated

Question 1.5: Which event is the most significant for the History Project of Nursing Informatics Pioneers?

a. They video-taped interviews of nurse practitioners

b. Archival material from NI Pioneers was submitted to the NLM for the NI History Collection

c. Developed Use Cases on how to teach NI

d. Developed rules for NI mentorship

Question 1.6: What are the themes from the interviews of the NI Pioneers?

a. They had a vision that technology could make nursing practice better. True ___ False ___

b. They highlighted what nurses brought to the HIS table. True ___ False ___

c. They indicated that they selected a career of NI. True ___ False ___

d. They knew that they were NI experts. True ___ False ___

e. They learned NI through hands-on experiences. True ___ False ___

Question 1.7: What Nursing Standards have impacted on the nursing profession?

a. Education, Administration, Content, and Practice

b. Practice, Content, Confidentiality and Security, and Education

c. Confidentiality and Security, Research, Practice, and Education

d. Research, Administration, Education, and Practice

Question 1.8: What Nursing content and/or other technological materials are needed in EHRs?

a. SNOMED CT, Abdellah's 21 Problems, and Nursing Terminologies

b. Nursing Terminologies, Nursing Cannons, and NLM

c. Nursing Process Model, SNOMED CT, and a Coded Nursing Terminology

d. SNOMED CT, Nursing Cannons, Nursing Process

Question 1.9: What historical event initiated the need for computer-based health records?

a. IOM proposed that CPRs were critical and necessary as a new healthcare technology

b. CPRI was formed to develop technology standards

c. NCVHS proposed technology standards

d. Criteria for Davies Award of Excellence established

Question 1.10: What were the initial criteria for the Nicholas E. Davies Award of Excellence Program?

a. Impact, Quality Indicators, Management, and EHR

b. Management, Technology, Functionality, and Impact

c. Technology, Impact, Quality Indicators and Management

d. Functionality, Acute Care, Impact, and Quality Indicators

ANSWERS AND EXPLANATIONS

Question 1.1: (a) Physiological Monitoring Systems in Hospital ICUs. Such system were introduced in the ICU's by HP but were not linked to the nursing units. When the patient was transferred to the medical/surgical units all the data was lost.

Question 1.2: (c) ANA approved the formation of the Council on Computer Applications in Nursing (CCAN) in 1986. The CCAN was introduced by Werley and Saba, to the Congress of Nursing Practice and approved by them.

Question 1.3: (c) ANA recognized Nursing Informatics as a new nursing specialty (in 1991/1992). The CCAN, renamed the Steering Committee on Databases to Support Nursing Practice Committee, submitted the request to the Congress on Nursing Practice to accept Nursing Informatics as a new nursing specialty in fall 1991 and was approved early in 1992.

Question 1.4: (c) ONC was established and the first ONC Coordinator named. In 2004 the Office of the National Coordinator for Health Information Technology (ONC) was established and Dr. David Brailer named as the first National Coordinator.

Questions 1.5: (b) Archival material from the NI pioneers collected and submitted to the NLM for the NI History Collection. The History Project of Nursing Informatics Pioneers was first established in the late 1990s but restarted by AMIA-NIWG in 2004. One of the first activities was the call for and the collection of papers and other unpublished materials from NI Pioneers for a NI History Collection being established in the NLM.

Question 1.6:

a. True

b. True

c. False

d. False

e. True

The NI pioneers were interviewed and their rich stories captured from approximately 145 identified pioneers who shaped the field since the 1960s.

Question 1.7: (b) Practice, Content, Confidentiality and Security, and Education.

The third significant historic perspective focused on nursing content as well as on federal legislation that impacted on the use of computers for nursing practice.

Question 1.8: (c) Nursing process, SNOMED CT, and a coded Nursing Terminology.

The Nursing Process data elements were considered essential for the exchange of nursing Information across Electronic Healthcare

Record EHR Systems. Also, HHS designated SNOMED CT as essential for the interoperability of patient care data. Thus all nursing terminologies had to be mapped to SNOMED CT to be implemented in EHRs.

Question 1.9: (a) IOM proposed that CPRs were critical and necessary as a new healthcare technology. In 1989 the Institute of Medicine (IOM) of the National Academy of Sciences convened a meeting and published a report by Dick and Stein recommending that computerized patient record (CPR) systems were essential technology for healthcare in order to improve outcomes in healthcare quality, cost, and access.

Question 1.10: (b) Management, Technology, Functionality, and Impact. The Davies Award emerged from the CPR work established by the IOM. The criteria formed the basis for outside reviewers to measure and evaluate the accomplishments of the CPR.

2

Computer Hardware

• OBJECTIVES

1. Identify the essential hardware components of a computer.
2. List key peripherals attached to most computers.
3. Describe the four basic operations of the central processing unit (CPU).
4. Explain how power is measured for computers.
5. Describe common computer input, output, and storage devices.
6. List the names for six types of computers and describe how they are different.
7. Describe computer network hardware devices and their functions.

• KEY WORDS

CPU (central processing unit)
Motherboard
Memory
Peripherals
Hardware

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of computer hardware? Can you define computer hardware? Why is it important for nurses to learn about computer hardware? How do computers store data? Can you give examples of health data that would be stored in a computer? How do nurses retrieve data from a computer? What type of computer hardware is in your doctor's or nurse practitioner's office?

For a WIIFM statement, say to the class, "This chapter covers various aspects of computer hardware: components and their functions and classes of computers and their characteristics and types. It also highlights the functional components of the computer and describes the devices and media used to communicate, store, and process data. Major topics addressed include basic computer concepts and classes and types of computers, components, and computer communications. To understand how a computer processes data, it is necessary to examine the component parts and devices that comprise computer hardware." As a nurse, it is important to understand computer hardware.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to retrieve listed references for review
3. Encourage students to visit A Tour Inside a Desktop PC website to tour inside a computer

Timing

1. Lecture 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OVERVIEW

Introduction

1. Computer hardware is defined as all of the physical components of a computer

2. A computer is a machine that uses electronic components and instructions to the components to perform
   a. Calculations
   b. Repetitive and complex procedures
   c. Process text
   d. Manipulate data and signals
3. Computer technology has evolved from huge, room-sized electronic calculators developed with military funding during World War II to palm-sized machines
4. The basic hardware of a computer composes the computer's architecture, and includes
   a. Electronic circuits
   b. Microchips, processors
   c. Random Access Memory (RAM)
   d. Read-Only Memory (ROM)
   e. Graphic and sound cards
5. These are attached to a component called a motherboard
6. The motherboard is a square or rectangular board with circuits into which are plugged the main electronics of the computer
7. Devices that may be inside the computer case but are not part of the architecture include
   a. Main storage device which is usually an internal hard drive
   b. Cooling system
   c. Modem
   d. Ethernet connectors
   e. Optical drives
   f. Universal Serial Bus (USB) connectors
   g. Multi-format media card readers
8. Devices attached or linked to a computer that are peripheral to the main computer box are part of the system's hardware
9. These include
   a. Input and output devices, including the keyboard, touch screen, mouse, printer, and fax
   b. Storage components such as external hard drives, thumb drives, floppy drives, tape drives, sound systems (earphones, microphones, speakers, subwoofers)
   c. Computer monitor
10. Computer systems are composed of many different component parts that enable the user to communicate with the computer, and with other computers to produce work
11. The group of required and optional hardware items that are linked together to make up a computer system is called its configuration
12. When computers are sold, many of the key components are placed inside a rigid plastic housing or case, which is called the box
13. What can typically be seen from the outside is the box containing the internal components, and the peripherals such as a keyboard, mouse, speakers, monitor, and printer
14. Computers are now pervasive throughout the healthcare industry
15. Their applications are expected to continue to expand and thereby improve the quality of healthcare while at the same time reducing some costs
16. The applications of computers to healthcare will greatly expand the diagnostic and therapeutic abilities of practitioners and broaden the diagnostic and treatment options available to recipients of healthcare
17. Computers allow for distance visualization and communication with patients in remote areas
18. None of these changes could have happened without tremendous advances in the machinery, the hardware, of computers

Teaching Tip
Provide these examples from the chapter regarding computer hardware advancement in healthcare

- Computer hardware advances during the late 1900s and into the 2000s have made possible many changes to the healthcare industry
- The first work to be modified consisted of special administrative functions such as finance, payroll, billing, and nurse staffing and scheduling support
- Later, the computer allowed fantastic changes in the practice of radiology and imaging, allowing noninvasive visualization not only of internal structures, but even of metabolic and movement functioning
- Computer enhanced surgical instruments enabled surgeons to insert endoscopy tools that allow for both visualization and precise removal of diseased tissues, leaving healthy tissues minimally damaged and the patient unscarred
- Virtual reality programs in surgery have greatly enhanced the scope and complexity of surgeries that are now amenable to much less invasive surgeries
- As a result, massive damage to skin, subcutaneous tissues, muscles, and organs have been eliminated from many procedures
- Millions of patients who formerly would have needed weeks in the hospital for recovery are now able to be released from the hospital the same day of their surgery or in a day or two at most
- Telemedicine is now being used to reduce the impact of distance and location on accessibility and availability of healthcare

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Required Hardware Components of a Computer

1. The box of any computer contains a motherboard
   a. The motherboard is a thin, flat sheet made of a firm, nonconducting material on which the internal components—printed circuits, chips, slots, and so on—of the computer are mounted
   b. The motherboard is made of a dielectric or nonconducting plastic material
   c. Electric conducting lines are etched or soldered onto the bottom of the board
   d. The motherboard has holes or perforations through which components can be affixed so they can transmit data across the circuits on the motherboard

   - **e.** One side looks like a maze of soldered metal trails with sharp projections (which are the attachments for the chips and other components affixed to the motherboard)
   - **f.** The motherboard contains the microchips (including the CPU), and the wiring, and slots for adding components
   - **g.** The specific design of the components on the motherboard—especially the CPU and other microprocessors—composes the foundation of the computer's architecture
   - **h.** The motherboard's storage media is called memory

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Memory

1. Read-Only memory
   - **a.** It is a form of permanent storage on the computer
   - **b.** It carries instructions that allow the computer to be booted (started), and other essential machine instructions
   - **c.** Its programming is stored by the manufacturer and cannot be changed by the user
   - **d.** Data and programs in ROM can only be read by the computer, and cannot be erased or altered by users
   - **e.** Theoretically, ROM can be changed by the factory
   - **f.** Effectively, the programs are permanently wired into the memory
   - **g.** ROM generally contains the programs, called firmware, used by the control unit of the CPU to oversee computer functions
   - **h.** In microcomputers, this may also include the software programs used to translate the computer's high-level programming languages into machine language (binary code)
   - **i.** ROM storage is not erased when the computer is turned off
2. Random access memory (RAM)
   - **a.** Refers to working memory used for primary storage
   - **b.** It is used as temporary storage
   - **c.** Also known as main memory, RAM can be accessed, used, changed, and written on repeatedly
   - **d.** RAM is the work area available to the CPU for all processing applications
   - **e.** When a user clicks on a program icon, the computer loads all or part of the program into RAM where it can be accessed very quickly
   - **f.** It saves work done through the programs until the user formally saves the work on the hard drive or other permanent storage
   - **g.** RAM is a permanent part of the computer
   - **h.** RAM is called volatile memory because everything in RAM unloads (is lost) when the computer is turned off
   - **i.** The computer programs that users install on their computers to do work or play games are stored on media such as on the hard drive
   - **j.** They are not permanent parts of the computer itself
   - **k.** Running programs from the hard drive would be a very slow process, so parts of the programs are loaded and unloaded from the much faster RAM as needed
   - **l.** They are unloaded when the user shuts the program down or turns off the computer
   - **m.** The contents of RAM are erased whenever the power to the computer is turned off
   - **n.** RAM is made ready for new programs when the computer is turned on again
3. Cache
   - **a.** A smaller form of RAM
   - **b.** Its purpose is to speed up processing by storing frequently called items in a small, rapid access memory location
   - **c.** Prior to the development of cache, all information had to be fetched from the hard drive, and then stored in RAM
   - **d.** To handle all the work, the processor had to move information into and out of RAM (and back to the hard drive) in order to manage all the data from programs and their output
   - **e.** Given that RAM is large it takes a bit of searching to find just the pieces needed and is relatively slow
   - **f.** Fetching from cache takes much less time than from RAM
   - **g.** Keeping information that will be used frequently in cache greatly reduces the amount of time needed to move data around among the memory locations
   - **h.** It is a relatively inexpensive way to increase the speed of the computer

Teaching Tip
Provide this example from the chapter to help the students better understand cache.

- To understand how cache works, think of a surgical nursing unit
- Prior to the 1980s, many hospitals did not have many volumetric pumps, and all were kept in the Central Supply (CS) department—usually far away in the basement
- Whenever a nurse needed a pump (which at that time were used only for especially dangerous IV medication infusions), the nurse had to go to CS and fetch it
- When no longer needed for that patient, the pump was returned to CS
- This is analogous to a system with no cache
- This was a good system when pumps were seldom used on any unit as storage space is always limited in nursing units
- Consider changes in practice which have led to the need for one or more volumetric pumps used for every patient
- The new plan is to have a storage area in the nursing unit so when one is needed, the machines are always nearby
- This system is much more efficient for the nurses. Having a space to store the pumps nearby greatly reduces the time needed to access a pump
- Rarely used equipment is still often kept in the CS department, but frequently needed items have a nearby storeroom so they can be retrieved more quickly and efficiently
- This is similar to cache

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Input and Output

1. Input devices
    a. These devices allow the computer to receive information from the outside world
    b. The most common input devices are the keyboard and mouse
    c. Others commonly seen on nursing workstations include the touch screen, light pen, voice, and scanner
    d. A touch screen is actually both an input and output device combined
    e. Electronics allow the computer to "sense" when a particular part of the screen is pressed or touched
    f. In this way, users input information into the computer
    g. The touchscreen displays information back to the user, just as does any computer monitor
    h. A light pen is a device attached to the computer that has special software that allows the computer to sense when the light pen is focused on a particular part of the screen
    i. It allows smaller screen location discriminations than does a touchscreen
    j. For both the touch screen and light pen, software interprets the meaning of the user identified screen location to the program
    k. Many other input devices exist
    l. Some devices are used for security and can detect users' fingerprints, retinal prints, voiceprints, or other personally unique physical characteristics that identify users who have clearance to use the system

Teaching Tip
Provide this example from the chapter to help the students better understand input devices used in healthcare.

- In healthcare computing, many medical devices serve as input devices
- For example, the electrodes placed on a patient's body provide input into the computerized physiologic monitors
- The oximetry device placed on a patient's finger uses light waves to detect impulses which are sent to a computer and then interpreted as oxygen levels in the blood
- Voice systems allow the nurse to speak into a microphone (which is the input device) to record data, submit laboratory orders, or request information from the computer
- In radiology, most machines today input images from the X-Ray machines to a computer rather than storing them on film
- The most advanced imaging machines could not exist without computer technology
- Computerized Axial tomography (CAT)-scans, and Medical Resonance Imaging machines are the best known computerized imaging devices, but most radiology today is computerized

2. Output devices
    a. These devices allow the computer to report its results to the external world
    b. Defined as any equipment that translates the computer information into something readable by people or other machines
    c. Output can be in the form of text, data files, sound, graphics, or signals to other devices
    d. The most obvious output devices are the monitor (display screen), and printer
    e. Other commonly used output devices include storage devices such as the Universal Serial Bus (USB) drive (also known as flash or thumb drives), and optical media

Teaching Tip
Provide this example from the chapter to help the students better understand output devices used in healthcare.

- In healthcare settings, a variety of medical devices serve as output devices
- Heart monitors are output devices recording and displaying heart rhythm patterns, and initiating alarms when certain conditions are met
- Volumetric infusion pumps output include both images on a screen and fluids infused into the patient's body
- The pump delivers a specific volume of IV fluids based on commands that the nurse inputs so the ordered fluid volume will be infused in the correct time period

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Storage Media

1. Hard Drive
    a. It is a peripheral that has very high speed and high density
    b. It is a very fast means of storing and retrieving data as well as having a large storage capacity in comparison with the other types of storage
    c. The hard drive is the main storage device of a computer
    d. For small computers, it is typically inside the case or box that houses the CPR and other internal hardware
    e. Internal hard drives are not portable; they are plugged directly into the motherboard
    f. The storage capacity of hard drives has increased and continues to increase exponentially every few years
    g. In 2014, most personal computers are sold with about a terabyte of storage
    h. In 1990 most personal computers came with about 500 megabytes
    i. On the biggest computers, storage is measured in petabytes, which is an almost unimaginably huge number

2. USB Flash Drive
    - **a.** As demands for higher and higher density transportable storage rise, the popularity of the USB disk has also risen
    - **b.** A USB flash drive is actually a form of a small, removable hard drive that is inserted into the USB port of the computer
    - **c.** There are many names for it, including pen drive, jump drive, thistle drive, and pocket drive
    - **d.** This is a device that can store 4 gigabytes (GB) for about $10
    - **e.** Flash drives can be very tiny, only about ½ in by 1 in
    - **f.** They can also be much bigger and can home 128 GB or more
    - **g.** The flash drive is highly reliable
    - **h.** Small enough to fit comfortably in a pants pocket or on a lanyard as a necklace, or on one's keychain
    - **i.** The device plugs into one of the computer box's USB ports and instead of saving to hard drive or CD-ROM or disk, the user simply saves to the flash drive
    - **j.** Can store so much data in a package so much smaller than a CD or DVD, the convenience makes it worth the slightly higher price to many users
    - **k.** As its popularity increases, prices drop

Teaching Tip

Provide this example from the chapter to help the students better understand about the use of the USB Flash Drive in healthcare as well as the potential dangers.

- Flash drives are not really used in clinical settings, at least not for business or patient care purposes
- However, they are often carried by personnel who may plug them into the hospital's computer to do personal work
- There is a danger that they can end up used to compromise patient or company confidentiality
- Nurses should not save confidential patient information onto their personal flash drive (or any other personal storage devices)
- It is too easy to lose the drive itself, and then confidential information could end up anywhere!
- With paper medical records, a person had to laboriously hand copy confidential information onto a piece of paper to create such a risk to confidentiality
- With electronic media, it is perilously easy to copy confidential information, and since it then becomes so accessible, there is little security for that information
- As nurses are responsible for protecting confidential information, as both a personal and company policy, confidential patient or company information should not be downloaded onto personal storage devices without a very good reason and legal permission to do so

3. Optical Media
    - **a.** Include Compact Disks (CDs), Digital Versatile Disks (DVDs), and Blu-Ray
    - **b.** CD-ROMs and DVDs are rigid disks that hold a higher density of information and have higher speed
    - **c.** Until the late 1990s, CD-ROMs were strictly input devices
    - **d.** CD-ROMs were designed to store sound and data, and held about 737 megabytes of information and large laser writers were required to store data on them
    - **e.** CD-ROMs were read-only media
    - **f.** Technology developed in the 1980s by Philips Corporation permitted the development of a new type of CD that could be written on by the user
    - **g.** Those are called CD-RW for Compact Disc Read-Write
    - **h.** As technology advanced and people wanted to store motion pictures on computer readable media, DVDs were developed and they held approximately 4.3 gigabytes of information, which will handle a regular 2 hour movie
    - **i.** DVDs are too limited to handle high definition movies and movies longer than 2 hours
    - **j.** Media moved to the even higher storage capacity of Blu-Ray discs which store approximately 27 gigabytes of information or the equivalent of a 2 hour high definition movie
    - **k.** Double layer Blu-Ray discs can store 54 gigabytes or 4.5 hours of high definition motion picture media
    - **l.** Blu-Ray is derived from the blue color of the laser that writes on the media and ray for the optical ray that reads the media

4. Other Storage Devices
    - **a.** As computers became more standard in offices during the 1990s, more and more corporate and individual information was stored solely on computers
    - **b.** Even when paper backup copies were kept, loss of information on the hard drive was usually inconvenient at the least and a disaster at worst
    - **c.** Diskettes could not store large amounts of data, so people began to search for economical and speedy ways to back up the information on their hard drive
    - **d.** Zip drives, which were mini magnetic tape devices, were a form of relatively fast (in their time) backup storage for people's data
    - **e.** Thumb (USB) and external hard drives were faster than tape media and replaced it as the backup media of choice
    - **f.** Today, many people purchase services that allow them to back up their data online, which means it gets stored on commercial computers that they have backup facilities

5. Cloud Storage
    - **a.** An extension of the online storage service offered by individual vendors
    - **b.** Data stored in the "Cloud" is still stored on commercial computers called servers
    - **c.** The "Cloud" refers to a distributed system of many commercial, networked servers that communicate through the Internet, and work together so closely that they can essentially function as one large system
    - **d.** Physically, enormous numbers of servers that store data are located in buildings, many warehouse sized
    - **e.** These data storage sites are called *data centers*
    - **f.** Multiple data centers are linked together to create cloud storage
    - **g.** The advantage to the customer is safety of the stored data

  h. A key factor in cloud storage is redundancy
  i. The storage vendors must maintain multiple copies of the data they store
  j. If one server in a data center becomes inoperable, copies of the data on that server are stored elsewhere and thus the data are not lost
  k. They can be retrieved from another server
  l. There are numerous vendors who offer individuals free cloud storage space for their personal files, such as photos and music
  m. They may also offer storage for a modest monthly or yearly fee
  n. Some continuously back up data, others back up data at specified times, and typically the user can order files to be backed up whenever he or she wishes
  o. Cloud storage is far more secure and reliable than a personal hard drive or backup drives
  p. Most users of smartphones, tablet computers, and other portable devices store their data in the Cloud, not only because of the security of the data, but because storage in small devices is somewhat limited
  q. The Cloud allows more data storage than most individuals need for personal use

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Major Types of Computers

1. Supercomputers
  a. The largest type of computer
  b. First developed by Seymour Cray in 1972
  c. The early supercomputer research, development, and production was done by Cray Corporation or one of its affiliates (Cray, 2014)
  d. A supercomputer is a computational-oriented computer specially designed for scientific applications requiring a gigantic amount of calculations which, to be useful, must be processed at superfast speeds
  e. The supercomputer is truly a world class “number cruncher”
  f. Designed primarily for analysis of scientific and engineering problems and for tasks requiring millions or billions of computational operations and calculations
  g. Are huge and expensive
  h. Supercomputers are used primarily in such work as defense and weaponry, weather forecasting, advanced engineering and physics, and other mathematically intensive scientific research applications
  i. Provides computing power for the high-performance computing and communication (HPCC) environment
2. Mainframes
  a. The most common fast, large, and expensive type of computer used in large businesses (including hospitals and other large healthcare facilities) for processing, storing, and retrieving data
  b. It is a large multiuser central computer that meets the computing needs large and medium sized public and private organizations

Teaching Tip
Provide this example from the chapter to help the students better understand about the use of the mainframe computers in healthcare.

- Virtually all large and medium sized hospitals (300 beds and up) have a mainframe computer to handle their business office operations
- They may have the hospital’s electronic medical record (EMR) on that computer as well, or they may subcontract mainframe computing from a professional computer system support vendor

  c. Mainframes are used for processing the large amount of repetitive calculations involved in handling billing, payroll, inventory control, and business operations computing

Teaching Tip
Provide this example from the chapter to help the students better understand about the use of the mainframes.

- For example, large volume sales businesses like grocery store chains and the “big box” stores have mainframe computers tracking all sales transactions

  d. The machines and software that process transactions in high volume businesses are known as transaction processing systems (TPS)

Teaching Tip
Provide this example from the chapter to help the students better understand about the use of the mainframe computers in healthcare.

- The information nurses chart on patients in inpatient care facilities can be viewed as transactions
- For example, every time a nurse charts a medication, that charting records use of one or more drugs
- That charting in turn is transmitted to the pharmacy so that one item of that drug in inventory can be decreased
- Typically, when the count of remaining inventory drops to a certain level, the TPS automatically initiates an order to a pharmacy supply house for more of the drug
- Operations like charting a patient’s vital signs goes into that person’s medical record, and might trigger a warning to the nurse should any of the vital signs be out-of-range for that patient
- For example, if the blood pressure is too high or too low, the system might be programmed to signal a warning so the nurse is advised to assess the patient and take appropriate action
- Given the number of these kinds of “transactions” in clinical facilities, a powerful computer is needed to handle them all,

and therefore, the hospital's EMR and other clinical applications are often handled through a mainframe computer

e. Mainframes always have very high processing speeds (calculated in millions of processes per second, or MIPS, or in floating point operations per second, or FLOPS)

f. Prior to the year 2000, mainframes were often defined almost entirely by their high processing speed

g. Today's mainframes are more defined by the following characteristics than merely processing speed:

  (1) Their extensive input and output capabilities to support their multiuser environment

  (2) Complex engineering to support long term stability with high reliability, allowing these machines to run uninterrupted for decades

  (3) Their ability to process the massive throughput needed for high volume business transactions and business office operations

Teaching Tip

Provide this example from the chapter to help the students better understand about the use of the mainframe computers in healthcare.

- In hospitals, mainframe computers are often used to support the entire Hospital Information Technology System (HIT), also known as the Hospital Information System (HIS), purchased from one of the 30 or so large HIT vendors
- The HIT includes not only business and nursing operations, but supports many clinical systems
- As previously mentioned, the applications nurses use in hospitals and other large healthcare facilities to document patient care, obtain laboratory and radiology results, record medication orders and administration records, and perform many other nursing record-keeping and information retrieval tasks typically involve use of a hospital mainframe computer
- Virtually all inpatient healthcare facility departments need large amounts of computer support
- A partial listing of departments that typically have their systems on the hospital's mainframe computer includes: the laboratory and radiology systems, the dietary department, the admissions department and its patient location system, the pharmacy department, and the central supply department's inventory control system
- Sometimes clinical monitoring systems such as cardiac and fetal monitors, and surgery information systems may be housed on the mainframe, although these systems often reside on their own separate computer hardware
- Today the average sized or large acute care hospital has a HIT implemented by one of the 30 or so large HIT vendors
- It has a hardware configuration of a mainframe which may be located on-site (physically located at the hospital) or it might be located somewhere else
- In some cases, the Mainframe is not owned by the hospital, but by a computer service vendor who provides mainframe computing power to multiple customers
- In that case, the hospital's information is processed and stored on the vendor's computer systems

h. A mainframe is capable of processing and accessing billions (GB) of characters of data or mathematical calculations per second

i. Mainframes can serve a large number (thousands) of users at the same time

j. In some settings, hundreds of workstations (input and output devices that may or may not have any processing power of their own) are wired directly to the mainframe for processing and communication speeds faster than can be achieved with wireless communications

k. There are also wireless and telephone linkages into the computer so that remote users can gain access to the mainframe

l. As compared with a desktop PC, a mainframe has an extremely large memory capacity, fast operating and processing time, and it can process a large number of functions (multiprocessing) at one time

3. Microcomputers (Personal Computers or PCs)

a. While mainframe computers provide critical service to the healthcare industry, much smaller computers are also an essential part of healthcare computing systems

b. Computers designed to support a single user are called microcomputers or personal computers (PCs)

c. Much smaller and less powerful than a mainframe, PCs were designed to be used by one person at a time

Teaching Tip

Provide this example from the chapter to help the students better understand about the use of the PCs in healthcare.

- In hospitals, they are used for an increasing number of independent applications as well as serving as an intelligent link to the programs of the mainframe
- Hospital nursing departments use PCs to process specific applications such as patient classification, nurse staffing and scheduling, and personnel management applications

d. Microcomputers are also found in educational and research settings, where they are used to conduct a multitude of special educational and scientific functions

e. Desktops are replacing many of the mainframe attributes

f. Desktops can serve as stand-alone workstations and can be linked to a network system to increase their capabilities

g. This is advantageous, since software multiuser licensing fees are usually less expensive per user than having each user purchase his or her own copy

h. Computer size has steadily decreased since their invention while at the same time, power has grown exponentially

i. The components of desktop computer are typically housed in a hard case

j. While the size of the case can vary considerably, one common size is 2 ft long by 6 to 10 in wide

k. The case is most typically connected via wire or wireless technology to a keyboard, monitor, mouse, and printer

   - **l.** Microcomputers are also available as portable or laptop computers, and as notebook, tablet, and handheld computers
   - **m.** Laptop computers are highly portable because they are much are smaller than the standard desktop microcomputer
   - **n.** Many are less than 2 in deep
   - **o.** There is huge variation in the length and width, but if a 15 in viewing screen is used, the case is usually about 16 in by about 12 in
   - **p.** Notebook computers are even smaller; one size marketed in 2014 is 8.5 in × 11 in
   - **q.** Tablet computers are smaller with a width of about 7 in and length of about 9 in, but are super thin as compared with the laptop and notebook computers
   - **r.** Less than an inch deep, they end up widened due to the addition of a protective case that usually also serves as a stand

Teaching Tip
Provide this example from the chapter to help the students better understand about the use of the PCs in healthcare.

- Desktop and laptop computer systems with wireless connectivity to the hospital's computer are often placed on a rolling cart for use of the nursing staff in recording nursing notes, ordering tests and treatments, looking up medications, and other computer work in inpatient settings
- These computers on carts are often referred to as "WOWs" for workstation on wheels, or "COWs" for computer on wheels
- Many nurses find these rolling workstations to be much more useful than fixed computers at patient bedsides for a variety of reasons
- Additionally, one workstation can be assigned to a nurse to use with his or her assigned patients, thus eliminating the need for a separate computer for every bed
- This solution allows nurses to adjust screen height and location of the mouse on the COW for their physical comfort that day rather than having to readjust a separate computer at every bedside

4. Handheld Computers
   - **a.** Small, special function computers, although a few "full function" handheld computers were introduced in the late 1990s
   - **b.** Some have claimed to have almost the same functionality and processing capabilities as a laptop or notebook
   - **c.** Limited in their expansion possibilities, their ability to serve as full participants in the office network, and the peripherals they can support
   - **d.** More popular are the palm-sized computers, including personal digital assistants (PDAs), which are the smallest of the handheld computers
   - **e.** The PDA is a very small special function handheld computer which provides calendar, contacts, and note-taking functions, and may provide word processing, spreadsheet, and a variety of other functions
   - **f.** Originally sold as isolated devices, today virtually all PDAs are combined with telephone functionality and sold as **smartphones**
   - **g.** Smartphones are ubiquitous
   - **h.** Smartphones are owned by a huge number of people worldwide, from the slums of South Africa to business people in the most developed countries
   - **i.** Smartphones have replaced wristwatches, pocket calendars, and other personal items people used to keep their lives organized
   - **j.** Many people might be more comfortable leaving home without a coat in winter than without their smartphone.
   - **k.** These devices provide constant connectivity and access to Internet and telephone functions
   - **l.** They are particularly useful in that they can synchronize with other technology and provide automatic support for such things as the user's calendar
   - **m.** The processors for most smartphones, tablet computers, and other small but powerful devices are made by Advanced RISC Machines Ltd. (ARM)
   - **n.** A RISC processor is a "Reduced Instruction Set Computer," which means it is a special purpose processor
   - **o.** As of 2014, these processors are 32 bit microprocessors that use the RISC architecture
   - **p.** There are a variety of hardware platforms and operating systems for smartphones and tablet computers
   - **q.** The three most common are the Apple Corporation's iPhone and iPad using the iOS operating system, smartphones, and tablets using the Android operating system (owned by Google Corporation), and the Windows operating system for smartphones and tablets from Microsoft Corporation
   - **r.** The Android system is an open source operating system, the other two OS are closed and proprietary
   - **s.** There are thousands of software applications (called **apps**) developed for all these platforms, many of them free or sold at a very low price
   - **t.** Typically, the apps work on only the platform for which they were developed
   - **u.** Quite a few will work on both smartphones and tablets using that platform
   - **v.** For example, many apps that work on the iPad tablet will also work on the iPhone

Teaching Tip
Provide this example from the chapter to help the students better understand about the use of the apps in healthcare.

- Clinical applications can allow the nurse to obtain assessments such as electrocardiograms, heart and respiratory rate, hearing acuity, oxygenation, and blood pressure using a smartphone

- There are calculators that can make drug dosage calculations safer
- There are programs that can help identify drug facts such as actions and dosages, drug interactions, and remind the nurse of potential complications to watch for as well as special nursing actions to take with various medications
- Reminders can help the nurse avoid forgetting to perform a treatment or give a medication on time
- Wisely used, tablet computers, smartphones and other PDA technology have the potential to support patient care safety and quality in all settings of care

Teaching Tip
Provide this example from the chapter to help the students better understand about the limitations of handheld devices in healthcare.

- As wonderful as these handheld devices can be, there are pitfalls for nurses in their use in clinical areas
- They come with both still photo and video capabilities
- It can be very easy to forget the legal requirement for permission to photograph anything on a patient, much less make a photo of a patient's face when the technology is so available
- It is quite a simple matter to upload information stored on a smartphone onto the Internet
- A few nurses have found themselves in serious trouble when they forgot that social media, such as Facebook, Twitter, and LinkedIn are not private spaces and they uploaded photographs of patients or confidential patient information on social media.
- Smartphones are incredibly easy media on which to store information
- Nurses must remember that most information in their workplace has confidentiality requirements that can be protected only with sophisticated technical barriers to unauthorized access
- Those barriers are typically not available in an individual's smartphone

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Connectivity, Compatibility, and Incompatibility Issues

1. Communication among various hardware devices cannot be assumed.
    - **a.** Given that departments within a single organization have often bought small systems designed to support their work, a single hospital may have literally hundreds of different computers and applications on those computers
    - **b.** Simply wiring incompatible machines so that power can flow between them accomplishes nothing
    - **c.** Often, computers cannot transfer data meaningfully among themselves
    - **d.** This makes it difficult to create a comprehensive medical record for individual patients
    - **e.** Information stored somewhere in the facility may not be available when needed to the providers who need the information to make good patient care decisions
    - **f.** As greater attention is placed on patient safety and quality improvement, and on analysis of performance data for planning and evaluation, there is a need to acquire and combine data from multiple patient care operations computers and systems
2. Different computers have different architectures, hardware configurations, and different storage schemes
    - **a.** Software must be specifically designed to communicate with another program for the two to communicate
    - **b.** Systems not designed specifically to work together cannot communicate information and processes to each other without the addition of complex translation programs (that usually don't exist); that is, they are not interoperable
3. As a result of the interoperability problems, it can be economically infeasible to move data across different computers and programs.
    - **a.** The interoperability problem limits the nurses' ability to obtain, combine and analyze data they need to provide high quality, safe patient care
    - **b.** Organization progress and performance is hampered when data and information are not available to perform the analysis required to identify problems, opportunities for improvement, safety risks, and to make projections about future needs
    - **c.** Interoperability is necessary to meet the requirements of the Medicare and Medicaid EHR Incentive Programs (which provide financial incentives for the "meaningful use" of certified EHR technology) as part of the HITECH Act of 2009
    - **d.** Interoperability usually requires interoperable software programs such as SNOMED CT and LOINC

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Computer Power

1. Bits and Bytes
    - **a.** A bit (binary digit) is a unit of data in the binary numbering system
    - **b.** Binary means two, so a bit can assume one of two positions
    - **c.** A bit is an ON/OFF switch—ON equals the value of 1 and OFF equals 0
    - **d.** Bits are grouped into collections of 8, which then function as a unit
    - **e.** That unit describes a single character in the computer, such as the letter A or the number 3, and is called a byte

   f. There are 255 different combinations of 0 and 1 in an 8-character (or 1-byte) unit
   g. That forms the basic limit to the number of characters that can be directly expressed in the computer
   h. The basic character set hardwired into most PCs contains 255 characters
   i. In the early days of PCs, this was a problem because it severely limited the images that could be produced
   j. With the advent of graphics cards and the additional character sets and graphics that graphics cards allow, virtually any character can be produced on a computer screen or printed on a printer
   k. Even without graphics cards, additional character sets can be created by means of programming techniques
   l. The size of a variety of computer functions and components is measured by how many bytes they can handle or store at one time
2. Main memory, which includes the ROM on the motherboard in today's computers, is very large as compared with that of just a few years ago, and continues to increase every year with new computers
   a. The size of memory is an important factor in the amount of work a computer can handle
   b. Large main memory is another key measure in the power of a computer
   c. In the mid-1970s, the PCs on the market were typically sold with a main memory of between 48 and 64 K
   d. By 2014, the size of main memory in computers sold to the public had risen exponentially
   e. Most computers in 2014 are advertised with between 5 and 16 GB of main memory and computers with 20 GB or more of main memory are available
   f. Cache has also become an important variable in computer power and thus in advertising the power of computers
3. Another important selling point of a computer is the size of the hard drive that is installed in the box
   a. The first hard drives sold for microcomputers in the 1970s were external devices that stored about 1,500 kilobytes
   b. At that time, home computers were not sold with internal hard drives
   c. When the user turned on the computer, they had to be sure the operating system (OS) diskette was in the disk drive, or the computer could not work
   d. This architecture severely limited the size and functionality of programs
   e. Consumer demand for hard drives was such that their size grew exponentially while at the same time the cost of hard drive storage decreased exponentially.
   f. By late 1999, home computers sold typically had between 6 and 20 GB of space on the hard drive
   g. In 2010 the typical laptop computer was sold with a 300 to 500 GB hard drive
   h. Desktops often came with hard drives that offered a terabyte or more of storage
   i. By 2014, most home and laptop computers were advertised with 1 to 2 terabyte hard drives
   j. Hard drive space will undoubtedly continue to increase
   k. Applications programs have become so large that both the main memory and the hard drive storage space have had to increase exponentially

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Computer Speed

1. The basic operations of the CPU are called cycles
   a. The four types of cycles, or operations of a CPU, include:
      (1) Fetch
      (2) Decode
      (3) Execute
      (4) Store
   b. It takes time for the computer to perform each of these functions or cycles
   c. The CPU speed is measured in cycles per second, which is called the clock speed of the computer
   d. One million cycles per second is called 1 megahertz (MHz)
   e. A billion cycles per second is called 1 gigahertz (GHz)
   f. CPU speed is very fast because computers perform many billions of cycles per second
   g. They can be slow if their processors have insufficient speed for the work they are required to process
2. Clock speeds, like most other components, have greatly improved over time
   a. For example, the original IBM PC introduced in 1981 had a clock speed of 4.77 MHz (4.77 million cycles per second)
   b. In 2010, home computers commonly had speed of 1.8 to 3 GHz. In 2014, advertised computers in the $1000 range have clock speeds of 2.5 to 3 GHz
   c. The higher the clock speed possessed by the CPU, the faster and (in one dimension) the more powerful the computer
   d. Clock rate can be misleading, since different kinds of processors may perform a different amount of work in one cycle
   e. General purpose computers are known as complex instruction set computers (CISCs) and their processors are prepared to perform a large number of different instruction sets
   f. A cycle in a CISC computer may take longer than that for a specialized type of computer called a reduced instruction set computer (RISC)
   g. Clock speed is one important measure of the power of a computer

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Network Hardware

1. A network is a set of cooperative interconnected computers for the purpose of information interchange
2. The networks of greatest interest include local area networks (LANs), wide area networks (WANs), and the Internet, which is a network of networks
    - **a.** A LAN usually supports the interconnected computer needs of a single company or agency
    - **b.** The computers are physically located close to each other, and generally, only members of the company or agency have legitimate access to the information on the network
    - **c.** WANs support geographically dispersed facilities, such as the individual grocery stores in a national chain
    - **d.** A subset of WANs includes the metropolitan area networks (MANs) that support and connect the many buildings of local governmental agencies or university campuses
3. The most important components of network hardware are the adapter or interface card, cabling, and servers
4. The role of hardware in a network is to provide an interconnection between computers
5. For a computer to participate on a network, it must have at least two pieces of hardware:
    - **a.** Network adapter or network interface card
        - **(1)** A network interface card (NIC) is a computer circuit board or card that is installed in a computer so that it can be connected to a network
        - **(2)** PCs and workstations on LANs typically contain a NIC specifically designed for the LAN transmission technology, such as Ethernet
        - **(3)** NICs provide a dedicated, full-time connection to a network
        - **(4)** Most home and portable computers connect to the Internet through modems on an as-needed dial-up connection
        - **(5)** The modem provides the connection interface to the Internet service provider
        - **(6)** The oldest network interface (or “adapter card”) is an Ethernet card
        - **(7)** Wireless network modems are used more often today
        - **(8)** There exist other options such as arcnet and serial-port boards
        - **(9)** The choice of NIC depends on the communication medium
    - **b.** Communication medium (cabling)
        - **(1)** ***Distance.*** Relatively short distances are required for wireless, compressed video and coaxial cable systems. For much longer distances, fiber-optics, telephone lines, and satellite transmission are used
        - **(2)** ***Amount of data transfer.*** Large amounts of data (especially video) are best handled with coaxial cables and compressed video and through satellite communications (satellite and compressed video are very expensive). Smaller amounts of data or serial (nonvideo) streams are best handled through the other wire types, such as twisted pair copper wire and optical fiber, and are less expensive
        - **(3)** ***How often the transfer is needed.*** Coaxial works best for locally wired networks that are used constantly by a very limited number of users. Telephone wires work well for the relatively high usage public networks (like the Internet) but are more likely to get overloaded when many users try to use the system at the same time. Consider, for example, the busy Internet or phone lines getting clogged up when a tornado or hurricane has struck a community
        - **(4)** ***Availability.*** Availability depends on cost, transmission speed, number of users (who might clog up the system), and weather conditions (satellites)

Teaching Tip

Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

CONCLUSION

The chapter concludes by giving emphasis to the following:

- This chapter introduced the fundamental hardware of computers and networks
- The computer is generally described in terms of several major characteristics of its hardware
- The speed is determined by how many cycles per second can be processed, the size of its main memory, its cache, and its hard drive
- All these factors combine to determine how many programs and data can be permanently stored on the hard drive and how fast the computer can run programs
- In turn, these factors determine what kinds of work the user can do with the computer
- Playing online games is one activity that takes a large amount of computing power
- As a result, “gaming computers” are known to have a lot of computer power
- The physical components of the computer itself and its peripheral hardware constitute the architecture of the computer, and these factors determine how it can be used
- A great deal of work and playing on computers today involves interactions with other people and machines
- Thus, multiple computers must be able to be connected or networked with each other
- All the work performed and games played with computers require essential components, including a motherboard, printed circuits, a CPU, other processors, memory chips, controllers, and peripheral devices

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter

Teaching Tip

Review the learning objectives

- Identify the essential hardware components of a computer
- List key peripherals attached to most computers
- Describe the four basic operations of the CPU
- Explain how power is measured for computers
- Describe common computer input, output, and storage devices
- List the names for six types of computers and describe how they are different
- Describe computer network hardware devices and their functions

Teaching Tip

Ask the students to define the keywords

- CPU
- Motherboard
- Memory
- Peripherals
- Hardware

CHAPTER REVIEW QUESTIONS

Question 2.1: What is the definition of Computer Hardware and what does it represent?

a. It is a Text Processor

b. It is a Set of Instructions that makes the Computer Work

c. It represents the Physical Components of a Computer

d. It represents an Electronic Calculator

Question 2.2: What are the four basic components for a computer?

a. CPU, Input/Output, Storage, and Software

b. CPU, Input/Output, Storage, and Controllers

c. Hardware, Input/Output, Storage, and CPU

d. Storage, Controllers, Hardware, and CPU

Question 2.3: What are the three key types of memory in a computer?

a. CPU, RAM, and Cache

b. CPU, Cache, and ROM

c. RAM, CPU, and Cache

d. Cache, ROM, and RAM

Question 2.4: What are the major types of storage media?

a. Motherboard, Hard Drive, Optical Media, and USB Flash Drive

b. Optical Media, USB Flash Drive, Motherboard, and Hard Drive

c. USB Flash Drive, Cloud Storage, Disk Storage, and Hard Drive

d. Hard Drive, Optical Media, USB Flash Drive, and Cloud Storage

Question 2.5: What best describes virtual storage?

a. Storage on a thumb drive

b. Storage in a computer hard drive

c. Storage on a CD

d. Cloud storage via the Internet

Question 2.6: What are the five basic types of computers?

a. Handheld, Microcomputer, PDAs, Mainframe, and Laptop

b. Laptop, Supercomputer, Mainframe, Microcomputer, and Personal Computer

c. Handheld, Supercomputer, Microcomputer, Mainframe, and PDAs

d. Mainframe, Personal Computer, Laptop, Microcomputer, and PDAs

Question 2.7: How is a computer described in terms of characteristics?

a. Speed, Memory Size, Cache, and Hard Drive

b. Hard Drive, Software, Speed, and Memory Size

c. Cache, Hard Drive, Programming Language, and Speed

d. Memory Size, Software, Hard Drive, and Speed

Question 2.8: What are the three types of networks or information exchange?

a. WWW, Internet, and LAN

b. LAN, Internet, and WAN

c. WAN, CPU, and LAN

d. Internet, WWW, and LAN

Question 2.9: On what characteristics is the communication medium mostly based?

a. Availability, Distance, Number of Telephone Lines, and Amount of Data Transfer

b. Distance, How often Data Transfer is Needed, Availability, and Amount of Data Transfer

c. Amount of Data Transfer, Number of Telephone Lines, and How often Data Transfer is Needed

d. How often Data Transfer is Needed, Availability, Satellites, and Distance

Question 2.10: What other components should a person have at home besides the basic computer hardware components?

- **a.** Monitor, Motherboard, Mouse, and Keyboard
- **b.** Printer, Monitor, Keyboard, and Mouse
- **c.** Mouse, Printer, RAM, and Keyboard
- **d.** Keyboard, Mouse, ROM, and Motherboard

ANSWERS AND EXPLANATIONS

Question 2.1: (c) It Represents the Physical Components of a Computer. They are the electronic components of electronic calculators developed during World War II to solve logistic problems.

Question 2.2: (b) CPU, Input/Output, Storage, and Controllers. The computer contains a "motherboard" which composes the foundation of the its architecture that controls the CPU, Input and Output devices, controllers, and storage units (memory).

Question 2.3: (d) Cache, ROM, and RAM. Memory refers to the electronic storage devices or chips on the motherboard of the computer. The three key types are (1) read-only memory (ROM), the main memory known as (2) random access memory (RAM), and (3) cache which is a smaller RAM designed to speed up processing of storage.

Question 2.4: (c) USB Flash Drive, Cloud Storage, Disk Storage, and Hard Drive. Storage includes not only main memory but also external devices on which programs and data are stored such as the four listed above.

Question 2.5: (d) Cloud storage via the Internet. Data stored "in the Cloud" is an extension on online storage via the Internet. It allows, for what appears, to be unlimited storage of data.

Question 2.6: (c) Handheld, PDAs, Supercomputer, Microcomputer, and Mainframe. The five basic types of general computers represent the different size computers that were developed as the technology advanced.

Question 2.7: (a) Speed, Memory Size, Cache, and Hard Drive. The different basic types of computers differ in size, composition, memory and storage capacity, processing time, and cost. These basis differences also advanced as the technology advanced.

Question 2.8: (b) LAN, Internet, and WAN. A network is a set of interconnected computers for the purpose of information exchange. Local area networks (LANs) support single organizations, wide area networks (WANs) support geographically dispersed organizations, and the Internet, which is a network of networks, supports global organizations.

Question 2.9: (b) Distance, How often Data Transfer is Needed, Availability, and Amount of Data Transfer. The communication medium is the means by which actual transfer of data from one site to another takes place.

Question 2.10: (b) Printer, Monitor, Keyboard, and Mouse. A home computer is a system that needs more than the basic hardware. It requires other components to meet the users' needs.

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3

Advanced Hardware and mHealth

• OBJECTIVES

1. Identify standards that provide the framework for communication.
2. Identify Internet protocols.
3. Identify standards that provide the framework for interoperability.
4. Describe the enabling technologies for collaborative care.
5. List two examples of the use of collaborative tools.

• KEY WORDS

Advanced hardware
Bluetooth
mHealth
Mobile device
Wi-Fi

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Is healthcare becoming mobile? Can you give examples? Can you give examples of how nurses might use a smartphone in patient care? Do you think the use of cloud computing applies to healthcare? What are some possible issues of using wireless communication in healthcare? How do you think mobile technology change the delivery of healthcare in the next five years?

For a WIIFM statement, say to the class, "In this chapter, you will learn about the use of advanced hardware in healthcare and eHealth. eHealth is supported by mobile devices. In addition to other importation considerations in eHealth, you will learn about the challenges to security and integrity of data in a mobile environment. As a nurse, it is important to understand about new care models that are driving a change in the way people think about the use of advanced hardware in healthcare.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Review the Internet for current mHealth and eHealth examples and initiatives

Time

1. Lecture 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Hardware

1. Advances in computer hardware continue two trends
    a. More powerful processing in ever-smaller packages
    b. More power distributed across machines, most commonly seen in cloud services
2. Tablets used to be a bridge between a desktop and a smartphone, allowing mobility, but lacking the range of computing capability of a laptop
3. This distinction is disappearing as tablets evolve to provide the same capability as a laptop
4. A smartphone is a powerful handheld computer with an operating system and the ability to access the Internet

5. Wearable devices collect physiological measures and wirelessly send that data to smartphones or cloud-services via the Internet
6. Implantable devices, such as an implantable cardioverter-defibrillator, not only monitor physiological responses, they also provide interventions
7. Research on injectable microchips continues, and raises many security, privacy, and ethical issues
8. Advances in large capacity redundant storage allow rapid access to massive amounts of data with steadily improving fault tolerance
9. Redundant arrays of independent disks (RAIDs) for replicating and sharing data among disks make it possible to store larger chunks of information than a single storage device can handle
10. The combination of accessibility and capacity can be used in healthcare for storage of large data sets such as genomics data
11. Making this storage accessible through the Internet allows mobile devices to overcome local storage limitations
12. The ability of a mobile device to access a large number of computers connected through a communication network and run a program or application on many connected computers at the same time is known as cloud computing
13. The length of time a mobile device can work powered by a rechargeable battery is the limiting factor for mobile computing
14. The most common complaint about the limitation of a mobile device is battery life
15. Battery life becomes problematic when there is a high level of background activity

Discussion Point
Why is it important for the nurse to understand computer hardware including mobile devices?

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Wireless Communication

1. The ability of a mobile device to connect with networks in multiple ways is the foundation of mobile computing and mHealth
2. Technology used to wirelessly communicate with a mobile device includes
    a. Mobile telecommunications technology
    b. Wi-Fi
    c. Bluetooth
    d. Radio-Frequency Identification (RFID)
3. Fourth generation (4G) networks
    a. Are replacing 3G networks
    b. Support all Internet Protocol (IP) communication
    c. Use new technology to transfer data at very high bit rates
    d. The International Telecommunications Union-Radio communications sector (ITU-R) sets the standards for International Mobile Telecommunications Advanced (IMT-Advanced) technology
    e. The peak speed requirements for 4G service are
        (1) 100 megabits per second for high mobility communication (e.g., communications while traveling by car or train)
        (2) 1 gigabit per second for low mobility communication (e.g., communications while walking or standing still)
    f. Technologies that do not fulfill 4G requirements, but represent the forerunners to that level of service by providing wireless broadband access include
        (1) Worldwide Interoperability for Microwave Access (Mobile WiMAX)
        (2) Long Term Evolution (LTE)

Discussion Point
Ask the students to discuss 3G networks and 4G network.

4. Wi-Fi
    a. Intended for general local network access
    b. Called a wireless local area network
    c. Bluetooth is intended for a wireless personal area network (WPAN)
    d. Wi-Fi and Bluetooth are complementary
    e. Wi-Fi is access point-centered
    f. Bluetooth is used for symmetrical communication
    g. Protocols covering wireless devices include
        (1) Wireless Application Environment (WAE), which specifies an application framework
        (2) Wireless Application Protocol (WAP), which is an open standard, providing mobile devices access to telephony and information services
    h. Wi-Fi is a technology that allows an electronic device to exchange data or connect to the Internet wirelessly using (in the United States)
        (1) 2.4 GHz Ultra High Frequency (UHF) waves
        (2) 5 GHz Super High Frequency (SHF) waves
    i. Advanced hardware makes this connection through a
        (1) Wireless network access point
        (2) Hotspot
    j. Wi-Fi is based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards
    k. To provide a level of security for the wireless connection, various encryption technologies are used, such as
        (1) Wi-Fi Protected Access (WPA)
        (2) Wi-Fi Protected Access II (WPA2)
    l. A type of Extensible Authentication Protocol (EAP) is used for interoperability
    m. Wi-Fi security concerns are covered by National Institute of Standards and Technology (NIST)

Discussion Point

Ask the class to use the Internet and report back on 802.11 standard and its importance.

Ask the class to use the Internet and explore the NIST website and the importance to healthcare.

5. Bluetooth
    - **a.** Is a wireless technology standard for control of and communication between devices, allowing exchange of data over short distances
    - **b.** Bluetooth is used to wirelessly connect
        - **(1)** Keyboards
        - **(2)** Mice
        - **(3)** Light-pens
        - **(4)** Pedometers
        - **(5)** Sleep monitors
        - **(6)** Pulse oximeters
    - **c.** The range is application specific
    - **d.** Bluetooth uses 2.4 to 2.485 GHz UHF radio waves
    - **e.** Can connect multiple devices
    - **f.** The Bluetooth Special Interest Group (SIG) is responsible for Bluetooth standards
    - **g.** Bluetooth security concerns are addressed by NIST
6. Radio-frequency identification (RFID)
    - **a.** Uses radio-frequency electromagnetic fields to transfer data, using tags that contain electronically stored information
    - **b.** RFID is used for equipment tracking and inventory control
    - **c.** Tags contain an integrated circuit for
        - **(1)** Storing and processing information
        - **(2)** Modulating and demodulating a radio frequency
    - **d.** Tags contain an antenna for receiving and transmitting the signal
    - **e.** The tag does not need to be in line of sight of the reader, and may be embedded in the object to be identified
    - **f.** The reader is a two-way radio transmitter-receiver that sends a signal to the tag and reads its response
    - **g.** Some RFIDs chips are dust-sized
    - **h.** Standards for RFID are set by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and others
    - **i.** The standards for information technology telecommunications and information exchange between systems are ISO/IEC 18092 and ISO/IEC 21481
    - **j.** Although the standard-setting bodies are international, frequencies used for UHF RFID in the United States are currently incompatible with those of Europe or Japan
    - **k.** Security concerns are addressed by using cryptography
    - **l.** RFID security concerns are addressed by NIST

Teaching Tip

Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Standards and Protocols

1. Network standards
    - **a.** Use of well-established standards and best practices allows global and easy access to networks and networked information
    - **b.** The networking model and communications protocols used for the Internet are commonly known as
        - **(1)** Transmission Control Protocol (TCP)
        - **(2)** Internet Protocol (IP) or TCP/IP
    - **c.** This suite of standards provides end-to-end connectivity specifying how data are
        - **(1)** Formatted
        - **(2)** Addressed
        - **(3)** Transmitted
        - **(4)** Routed
        - **(5)** Received at the destination
    - **d.** The Internet Engineering Task Force (IETF) maintains the standards for the TCP/IP Internet protocol suite
    - **e.** Some of the most commonly used protocols for Internet user interface services and support services include
        - **(1)** Simple Mail Transfer Protocol (SMTP)
        - **(2)** File Transfer Protocol (FTP)
        - **(3)** HyperText Transfer Protocol (HTTP)
    - **f.** Encryption provides
        - **(1)** Confidentiality
        - **(2)** Integrity for data sent over the Internet
    - **g.** Cryptographic network protocols to protect data in transport are
        - **(1)** Secure Sockets Layer (SSL)
        - **(2)** Transport Layer Security (TLS)
    - **h.** Protocols for encrypting data at rest include
        - **(1)** Pretty Good Privacy (PGP)
        - **(2)** GNU Privacy Guard (GPG)
2. Network standards for transmission of health data
    - **a.** Health Level Seven International (HL7) maintains the framework and standards for the
        - **(1)** Exchange
        - **(2)** Integration
        - **(3)** Sharing
        - **(4)** Retrieval of electronic health information
    - **b.** These standards are the most commonly used in the world for packaging and communicating health information from one party to another using language, structure, and data types
    - **c.** Allow seamless integration between systems
    - **d.** The HL7 standards support
        - **(1)** Management
        - **(2)** Delivery
        - **(3)** Evaluation of health services and clinical practice

  e. Clinical Content Object Workgroup (CCOW) is an HL7 standard protocol that enables different applications to synchronize at the user-interface level in real time
  f. CCOW allows applications to present information in a unified way

Discussion Point

Ask the class to summarize and explain why standards are important. Ask the class to review the HL7 website and summarize its importance to healthcare.

Teaching Tip

Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

MOBILE HEALTHCARE

Drivers of Mobile Healthcare

1. The 2012 documentary *Escape Fire: The Fight to Rescue Healthcare* is an urgent call to think differently about healthcare
2. Clinicians shifting from a focus on disease management to a focus on ending lifestyle disease may leverage the use of mobile platforms
3. According to the mHIMSS Roadmap, "patients and providers are leveraging mobile devices to seek care, participate in, and deliver care. Mobile devices represent the opportunity to interact and provide this care beyond the office walls"
4. Advancements in technology, federal healthcare policy, and commitment to deliver high-quality care in a cost-efficient manner have led to new approaches
5. The Affordable Care Act (ACA) leverages innovative technology to bring about "a stronger, better integrated, and more accessible healthcare system"
6. The current healthcare focus is on preventive and primary care to reduce hospital admissions and emergency department utilization
7. Engaging patients with the management of their chronic diseases helps them maintain their independence and achieve a high quality of life
8. Patients may make use of collaborative tools such as Secure Messaging to communicate with their healthcare team, and may find support through social interactions on a blog

Discussion Point

Is mHealth a passing fad? Why or why not?

Are patients and clinicians ready to embrace mHealth? Why or why not?

Teaching Tip

Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

Technology in Mobile Healthcare

1. Under the Affordable Care Act (ACA), innovative technology is seen as an integral component of an integrated, accessible, outcome-driven healthcare system
2. Mobile technology may be key to more effective preventative care, improved patient outcomes, improving access to specialized medical services, and driving system-wide cost reduction
3. mHealth
   a. The National Institutes of Health defines mHealth as "the use of mobile and wireless devices to improve health outcomes, healthcare services, and health research"
   b. A major component of mHealth includes timely access to clinical information such as the data contained in electronic health records (EHRs), personal health records (PHRs), and patient portals
   c. This information should be securely accessible by clinicians, patients, and consumers over various wireless mediums both inside and outside the traditional boundaries of a hospital, clinic, or practice
   d. The iPhone and Android operating systems have accelerated the proliferation of mobile data use
   e. By 2015, mobile data traffic will be some 20 times the 2010 level
   f. The concept of mHealth can be traced to the early 1990s when the first 2G cellular networks and devices were being introduced to the market
   g. The bulky handset designs and limited bandwidth deterred growth, lack of communication standards impeded interoperability, and batteries lasted less than 6 hours
   h. A major standards breakthrough occurred in 1997, enabling Wi-Fi capable barcode scanners to be used in hospital inventory management
   i. Shortly thereafter, clinicians began to take an increasing interest in adopting technologies
   j. At this time, nurses began to use personal digital assistants (PDAs) to run applications like general nursing and medical reference, drug interactions, and synchronization of schedules and tasks.
   k. This quick rate of adoption was quite notable for clinicians often considered technology adverse
   l. Increased processing capabilities and onboard memory created an appetite for more advanced applications
   m. Network manufacturers were beginning to offer Personal Computer Memory Card International Association (PCMCIA) wireless devices, creating an environment where retrofitted hospital computers or new laptops allowed nurses to access the Internet without adding network cabling
   n. In 2000, the Federal Communications Commission (FCC) dedicated a portion of the radio spectrum to wireless medical telemetry systems (WMTS), which was widely adopted for remote monitoring of a patient's health
   o. As data transmission rates increased, it became feasible for hospitals to run video or voice applications over the wireless networks
   p. Application Specific Devices (ASDs) are often integrated with nurse call systems and medical telemetry so nurses can receive alerts, alarms, and text messages

  - **q.** Many vendors are now beginning to offer the same type of nurse call integration and voice-over Wi-Fi capabilities on popular smartphones
  - **r.** Nurses soon became familiar with Computers on Wheels (COWs)
  - **s.** Evolved to workstations on wheels (WOWs)
  - **t.** More wireless devices were integrated into networks and a greater emphasis was placed on error detection and prevention, medication administration safety, and computerized provider order entry (CPOE)
  - **u.** Parallel to Wi-Fi technology evolution has been the growth in cellular technology
  - **v.** In many healthcare organizations, seamless roaming between the two systems is a reality
  - **w.** Nurses now have immediate access to patient data at the bedside

Discussion Point
Ask the students to give examples of mobile technologies they use in the clinical setting.

4. Infrastructure
   - **a.** mHealth is a wide variety of use cases that range from continuous clinical data access to remote diagnosis as well as guest Internet access
   - **b.** The role of video in healthcare is evolving as quickly as the standards
   - **c.** Hospital systems and ambulatory practices have started using products like FaceTime, Skype, Google Hangouts, and other consumer-oriented video-telephony and voice over Internet Protocol (VOIP) software applications for patient consults, follow-up, and care coordination
   - **d.** Overlay networks for medical devices are becoming obsolete as hospitals seek economies of scale by utilizing their existing Wi-Fi infrastructure
   - **e.** This places a heavy dependency on the Information Technology department (IT)
   - **f.** An important aspect of mHealth is patient or guest access to the wireless system
   - **g.** The guest access wireless network should be segregated
   - **h.** Healthcare organizations generally opt to provide free unencrypted access with a splash page that outlines terms and conditions
   - **i.** Terms and conditions address liability for the patient's Internet traffic
5. Real-time location services (RTLS)
   - **a.** Dates back to the 1990s
   - **b.** Can be used for asset location tracking, including medical equipment
   - **c.** Can show the status of equipment

Mobile Devices

1. Smartphones and tablets are ubiquitous in the healthcare setting
2. Mobile device performance has improved
3. Battery technology has improved
4. Many devices have high-resolution touch screens
5. Clinical information systems are designed to display well on smartphones and tablets
6. Smart devices will emerge as the primary computing device for all users
7. These devices already support text messaging, voice, and video

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

TELEHEALTH

Bring Your Own Device (BYOD)

1. A trend in healthcare IT
2. Users do not want multiple communication devices
3. Users often prefer their own device
4. Mobile Device Management products provide policy enforcement, remote wipe capability, and endpoint integrity
5. Device owners must be willing to abide by the hospital's mobile device policy

Discussion Point
Ask the students to discuss the policies in their healthcare organizations related to BYOD. What are the positive and negative aspects of BYOD?

Unified Communications

1. Continues to grow
2. Fed by the challenge to attain work-life balance
3. BYOD is becoming increasingly attractive in many organizations

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

FUTURE OF mHEALTH INSIDE HEALTHCARE FACILITIES

Considerations for mHealth Planning

1. The role of cellular networks in video and voice applications is expanding
2. Advances in 4G technologies are beginning to provide the bandwidth necessary for video conferencing and Video Remote Interpreting (VRI)
3. Remote monitoring of patients is increasingly viewed as essential for mHealth planning
4. By 2020, the majority of computing will be edge computing

5. Healthcare will become more patient-centered, and mobile and health visits will occur in the home, school, and office (mHIMSS, 2014d)
6. Data from home monitoring devices to fitness apps raise questions about which kinds of data will be aggregated
7. There will be questions about conventions for meta-tagging the source of that data
8. Ethical, legal, privacy, and security questions must be addressed

Setting the Stage for mHealth Adoption

1. Smartphones and tablets offer a new engagement model for patients, family members, and healthcare providers
2. Peripheral devices are becoming smartphone ready
3. Sensors can now measure heart rate, pulse, oxygen saturation levels, speed, and distance for exercise regimens.
4. Devices are emerging for daily blood tests, automated weight tracking, and sleep monitoring
5. EKGs can be registered and transmitted through a device no larger than a Band-Aid
6. The concept of home health has been a driving factor in the proliferation of remote monitoring devices (HIMSS, 2012b)
7. Thanks to advances in machine-to-machine (M2M) technology, patients can check their blood sugar, blood pressure, oxygen levels, and other vital signs at home with their results wirelessly transmitted to their healthcare providers
8. Providing cellular or Wi-Fi communications to the ambulatory practice and the patient's home is a technology trend that has seen affiliate physician offices partnering with larger hospital systems for access to the EHR and to leverage corporate IT services to provide Wi-Fi for their offices

Privacy and Security

1. The cornerstone of trust in healthcare is privacy and security
2. mHealth data presents a greater challenge to security and data integrity because this data is in a mobile environment
3. The data are not collected in stored access facilities and stored behind firewalls
4. Many of the same rules apply to mHealth as well as the physical hospital environment
5. mHealth must comply with all Health Insurance Portability and Accountability Act (HIPAA) mandates, Food and Drug Administration (FDA) regulations, Office of Civil Rights (OCR) enforcements, and requirements from other governing agencies
6. In a large number of security breaches, the thief simply carried the equipment out the door or removed it from a car
7. Size does not play a role in protecting the data
8. An organization is responsible for securing and verifying security
9. An organization is responsible for testing to locate vulnerabilities in systems
10. The goal of privacy and security is to provide as much effort as needed to protect patient's personal health information (PHI) from being compromised
11. The benchmark for privacy must be 100 percent secure PHI

Legal and Policy

1. State and national policy and regulations have not kept pace with technology innovation
2. The proliferation of mHealth technology creates several fundamental issues related to the custody of medical information:
    a. Who owns it
    b. Who can access it
    c. Under what circumstances
3. As information becomes more portable, the question raised is to what extent records of other providers should be incorporated into clinical records of the practice, hospital, or specialist
4. Clinical significance is the central consideration in the determination of whether wellness, monitoring, and other data transmitted by consumers to their providers should be incorporated into the patient's electronic health record
5. Incorporating vast amounts of routine data might detract from clinically relevant findings
6. When data is shared between patient and clinician from such devices, it is desirable to have a thorough understanding between the treatment team and the patient about how the data is going to be reviewed, incorporated (or not) into the record, and used in patient care
7. There has been reluctance to accept any data other than the information collected within the physical boundaries of the hospital or practice, with the exception of routine consultations
8. Hesitancy to accept outside data is based on the receiving provider's inability to verify the accuracy of the data
9. The paradigm is changing
10. Excluding data from other sources may provide an incomplete picture of the patient's care, resulting in inappropriate or substandard treatment
11. The term "social media" immediately brings to mind Facebook, LinkedIn, and Twitter
12. Social media applications are accessible at all times, and in all locations via smartphones
13. User content is developed and shared through platforms such as YouTube, and video is shared through services such as Skype and FaceTime
14. Social media also presents several types of legal and regulatory concerns:
    a. Professionalism
    b. Privacy

Teaching Tip
Summarize and review the content before beginning the next section. Provide an opportunity for the students to ask questions.

SUMMARY

The chapter concludes by giving emphasis to the following

- Great change is happening in healthcare and among healthcare professionals
- The new technology is mobile
- The new face of healthcare will be mHealth

Teaching Tip
Ask the students what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Identify standards that provide the framework for communication
- Identify Internet protocols
- Identify standards that provide the framework for interoperability
- Describe the enabling technologies for collaborative care
- List two examples of the use of collaborative tools

Teaching Tip
Ask the students to define the keywords

- Advanced hardware
- Bluetooth
- mHealth
- Mobile device
- Wi-Fi

CHAPTER REVIEW QUESTIONS

Question 3.1: What are the three hardware elements enabling mobile health (mHealth)?

a. CPU Size, Wireless Network Access, and Battery Life
b. Battery Life, Physical Device Size, and Modem
c. Wireless Network Access, Modem, and Battery Life
d. Physical Device Size, Wireless Network Access, and Modem

Question 3.2: What are the two major trends in Advanced Hardware?

a. Cloud computing, and more powerful processing
b. Tablets that bridge between desktop and smartphone and cloud computing
c. More powerful processing, and more power distributed across many computers
d. More power distributed across many computers, and cloud computing

Question 3.3: Which best describes wireless communication?

a. Networks that provide faster performance
b. Networks that supports only the Internet
c. Mobile computing device that connects with networks in multiple ways
d. New technology that transfers high bit rates

Question 3.4: Which best explains the purpose of Wi-Fi?

a. Technology that allows an electronic device to exchange data
b. Technology intended for only WWW access
c. Technology intended for only cloud computing
d. Technology that provides a level of security

Question 3.5: What represents types of wireless technology standards?

a. Bluetooth which controls the communication between devices. True ___ False ___
b. Radio-Frequency Identification technology that transfers data. True ___ False ___
c. Bluetooth Tags used for electronically stored information and used for inventory control. True ___ False ___
d. RFID Tags that contain an integrated circuit for storing and processing information. True ___ False ___
e. Security standards using cryptography RFID. True ___ False ___

Question 3.6: Which best describes the purpose of network standards?

a. Provides end-to-end connectivity
b. TCP is the acronym for the 'Internet'
c. Allows access to networks in a standardized way
d. HL7 standards for exchange of electronic data

Question 3.7: What best highlights mobile technology?

a. Timely access to clinical information
b. Use of Personal health records
c. Access to Patient portals
d. Wireless telemetry systems

Question 3.8: Which best represents the future of mHealth inside Healthcare Facilities?

a. Path toward consolidated, coordinated and value-based care
b. Access to TCP Internet Usage
c. Complete HL7 Coverage
d. Unified Internet communications

Question 3.9: What are the most common mHealth platforms?

a. Smartphones, Electronic Tablets, and Remote Technologies
b. Cellular Networks, Wireless Networks, and Mobile Devices
c. Electronic Tablets, Mobile Devices, and Cellular Networks
d. Remote Technologies, Smartphones, and Wireless Devices

Question 3.10: What best highlights the legal implications of mHealth technology?

a. Routine data is irrelevant and does not need to be saved

b. Clinical significance is central consideration for ownership of patient data

c. Data from outside healthcare facilities does not belong to the provider

d. Relevance of access to user data on Facebook

ANSWERS AND EXPLANATIONS

Question 3.1: (b) Battery Life, Physical Device Size, and Modem. Mobil health (mHealth) is accelerating due to the convergence of processing power and expanded storage (cloud computing services) available on mobile devices such as smartphones, advanced tablets, and wearable devices.

Question 3.2: (c) More powerful processing, and more power distributed across many computers. Generally these machines are commonly seen in cloud services. For example, tablets used to bridge between desktop and a smartphone allowing mobility but lacking the range of computing capabilities the laptop provides.

Question 3.3: (c) Mobile computing device that connects with networks in multiple ways. Technology used to wirelessly communicate with a mobile device includes mobile telecommunication technology such as Wi-Fi.

Question 3.4: (a) Technology that allows an electronic device to exchange data. Mobile telecommunication technology used to communicate with a mobile device.

Question 3.5:

a. True

b. True

c. False

d. True

e. True

Question 3.6: (c) Allows access to networks in a standardized way. The use of well-established standards allow global and easy access to networks and networked information in a standardized way. The networking model used for the Internet is commonly known as Transmission Control Protocol (TCP).

Question 3.7: (b) Use of Personal health records. Mobile technology can improve patient and family outcomes by delivering personalized services in the home using Smartphones, tablets, and/or laptops.

Question 3.8 (a) Path toward consolidated, coordinated, and value-based care. Cellular network coverage in hospitals has grown and provides for paging, and first-responder communication systems.

Question 3.9 (b) Cellular Networks, Wireless Networks, and Mobile Devices. Information Technology tools, mobile applications, and clinical information systems provide an evolving platform for effective delivery of clinical services, increased operational excellence, and cost containment.

Question 3.10: (b) Clinical significance is central consideration for ownership of patient data. Clinical significance is the central consideration in the determination of whether wellness, monitoring, and other data transmitted by consumers to their providers should be incorporated into the patient's EHR

4

Computer Software

• OBJECTIVES

1. Identify the three categories of software and their functions.
2. Describe four important analytic themes in Information Science.
3. Explain five types of programming languages and their general capabilities.
3. Discuss PDA applications that can be used as part of physical assessment.
4. Explain the differences among LANs, WANs, and MANs.

• KEY WORDS

Software
Information science
Programming languages
PDAs
Networks: LANs, WANs, MANs

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: What type of software programs do you use in clinical practice? What are examples of computer programming languages? Why should nurses know about computer programming? Should nurses be required to learning a programming language?

For a WIIFM statement, say to the class, "In this chapter you will learn about the three general types of software, computer languages, and programs that nurses use. Systems software controls the operations of the machine and how it works peripheral equipment and supports utility and applications programs. Utility software supports the efficiency, productivity, and security of the systems software and applications programs. Applications software includes all the programs the user employs to do the work for which the user got the computer. Additionally, you will learn that a computer cannot naturally "understand" human language. The language of the computer is machine language. Machine language is understandably very difficult for programmers. Therefore, more English-like languages have been developed to facilitate programming. As languages become more like English, they are described in terms of levels, and the higher the level, the more English-like the language. The various languages allow programmers to develop programs to meet many needs of both the workplace and personal users. For nurses, there are a large number of programs available in many workplaces to support charting, interpreting waveforms such as heart rhythms and breathing rhythms, controlling intravenous drip rates, calculating drug dosages, and many other work functions. Computing and software have become pervasive in nurses lives, and are tools that nurses use every day to provide high quality nursing care services. As a nurse, it is important to learn about software, computer languages, as well as programs used in the clinical setting.

Class Preparation

1. Review the references and websites listed at the end of the chapter in the textbook
2. Encourage students to visit programming language websites on the Internet

Timing

1. Lecture 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Categories of Software

1. There are three basic types of software
    - a. System software
    - b. Utility programs
    - c. Applications software
2. System software "boots up" (starts up and initializes) the computer system
    - a. It controls input, output, and storage
    - b. It controls the operations of the application software
3. Utility software consists of programs designed to support and optimize the functioning of the computer system itself
4. Application software includes the various programs which users require to perform day-to-day tasks
5. Some users claim a third type of software called utility programs
    - a. These are programs that are used
        - (1) To help maintain the system
        - (2) Clean up unwanted programs
        - (3) Protect the system against virus attacks
        - (4) Access the World Wide Web (WWW)
6. Sometimes it can get confusing as to whether programs are utility programs or system software because current system software packages usually include a variety of utility programs with the basic system software packages

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

System Software

- a. Basic Input/Output System (BIOS): The first level of system control is handled by the BIOS stored on a ROM chip on the motherboard
- b. The software on the BIOS chip is the first part of the computer to function when the system is turned on
- c. It first searches for an Operating System (OS) and loads it into the RAM
- d. The BIOS consists of a set of instructions permanently burned onto a computer chip, it is a combination of hardware and software
- e. Programs on chips are often called firmware, because they straddle the line between hardware and software
- f. For this reason, many computer engineers make a distinction between firmware and software
- g. From that perspective, the OS is actually the first level of system software

1. Operating system
    - a. An operating system is the overall controller of the work of the computer
    - b. The OS is software loaded from the hard drive into RAM as soon as the computer is turned on
    - c. Firmware cannot be upgraded without changing the hardware chip
    - d. The OS can be upgraded or entirely changed through software
    - e. The user can simply delete one system of OS files from the hard drive and install a new OS
    - f. Most users purchase a computer with the OS already installed on the hard drive
    - g. The OS can be purchased separately and installed by the user
    - h. OSs handle the connection between the CPU and peripherals
    - i. The connection between the CPU and a peripheral or a user is called an interface
    - j. The OS
        - (1) Manages the interfaces to all peripheral hardware
        - (2) Schedule tasks
        - (3) Allocates storage in memory and on disks
        - (4) Retrieves programs and data from storage
        - (5) Provides an interface between the machine and the user
    - k. One of the most critical tasks (from the user's perspective) performed by the OS involves the management of storage
    - l. In the early computers, there were no operating systems
        - (1) Every programmer had to include explicit instructions in every program to tell the CPU exactly where in RAM to locate the lines of program code and data to be used during processing
        - (2) The user had to keep track of thousands of memory locations, and be sure to avoid writing one line of code over another active line of code
        - (3) The programmer had to be careful that output of one part of processing did not accidentally get written over output from another part of processing
        - (4) The need for management of storage consumed a great deal of time and programming code, and it produced many errors in programs
        - (5) Those errors had to be discovered and corrected before the program would run correctly
        - (6) The lack of an OS made programming enormously time-consuming and tedious
    - m. In comparison, programming today—while still a difficult and time-consuming task—is much more efficient
    - n. Currently, with the size of programs, memory and storage media, no programmer could realistically manage all the storage
    - o. Operating systems allowed not only more complex programs and systems, but without them, there could be no home computers, except for machines owned by skilled programmers

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Utility software

1. Utility programs includes programs designed to keep the computer system operating efficiently
2. They do this by
    a. Adding power to the functioning of the system software
    b. Supporting the operating system or applications software programs
3. Utility programs are sort of between system software and applications software
4. Many writers identify this software as part of the system software category
5. Six types of utility software can describe the majority of utility programs, although there is no formal categorization system for such programs
6. The categories include at least
    a. Security software
        (1) Includes primarily antivirus, firewall, and encryption programs
        (2) Antivirus utilities serve primarily to guard against malicious programs inadvertently accessed
        (3) Firewalls are a type of security program that makes it much harder for unauthorized persons or systems to enter the computer and hijack or damage programs or data on the computer
        (4) Firewalls can include both additional hardware and utility software
        (5) The encryption software encodes the data so that it cannot be read until it is decoded
        (6) The HTTPS letters on a Web page address indicate that the site encrypts data sent through that site

Teaching Tip
Reinforce, the HTTPS letters on a Web page address indicate that the site encrypts data sent through that site. The encryption is sufficiently high level that it cannot be decoded without a program at the receiver site. This encryption makes buying and selling via the Internet much safer. Without such encryption, credit card and other very private data would not be safe to use to purchase anything via the Internet.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

    b. Disk management utilities
        (1) Designed to help the user keep hard disk space clean and efficient
        (2) Accomplished by analyzing the use of disk space, defragmenting the drive, and deleting duplicate files if the user so command
        (3) Many programs and Internet sites temporarily store information on the hard drive as part of their operations, but when those operations are finished, they don't clean the temporary files
        (4) Other disk management utilities include diagnostic programs designed to find problems with programs or the operating system so that they can be fixed

Teaching Tip
Reinforce, specifically, many programs and Internet sites temporarily store information on the hard drive as part of their operations, but when those operations are finished, they don't clean the temporary files. Such files can consume quite a bit of disk space over time, and disk cleaners can sometimes free up large amounts of disk space just by eliminating obsolete information.

    c. Backup utilities
        (1) Serve to help the users back up their data
        (2) Applications programs may be backed up, but usually that isn't necessary because legal copies of programs can be reloaded by the person who bought the license
        (3) Illegal (or *pirate*) programs are a different issue
        (4) The computer owner may not have a backup copy of illegally downloaded programs
        (5) Any computer component can fail
        (6) It is very important for users to back up any data they have saved that they don't want to lose permanently
        (7) Back up one's data to an external (removable) hard drive or an online backup location

Discussion Point
Ask the class to discuss their strategies regarding how they back up data on their personal computers.

Ask the class to describe the data backup by their employer.

    d. Screen savers
        (1) Computer programs that either blank the monitor screen or fill it with constantly moving images when the user is away from the computer
        (2) Does not turn it (and the monitor) completely off
        (3) Originally developed for old technology screens that would be damaged by having the same image on the screen for a long period of time
        (4) Modern computer screens have different technology and don't suffer that risk
        (5) Screen savers are often entertaining or beautiful to look at
        (6) Do provide a small measure of privacy as they hide whatever the user is working on when the user steps away from the computer
        (7) Unless linked with a program that requires the user to sign back in to access the regular screen, they don't provide security because a passing person could also tap a key to get back to the regular screen
        (8) Screen savers sometimes do require users to log back into their computer to turn off the screen saver, and those do have a security function

   - **(9)** Typically, screen savers activate automatically if the computer does not receive any input from the user for a preset time period
- **e.** Archival software
   - **(1)** Compresses information in files to be archived, and then stores them in a compressed form in some long term storage device
   - **(2)** When the files are retrieved, software must be used to unpack (or decompress) the data so that it can be read
   - **(3)** Terms used to describe the data compression performed by archival software include packing, zipping, compressing, and archiving as well as unpacking, unzipping, de-archiving, and extraction
   - **(4)** Compression can sharply reduce the size of a large file such that it can be made small enough to email to another person or location

Teaching Tip
Give the example, for Windows, programs such as WinZip and WinRar as well-known archival utilities.

- **f.** Programming environment support programs
   - **(1)** Used by program developers to support their programming work or to run their programs
   - **(2)** Computers cannot read or understand human language
   - **(3)** Programs must change the language in which developers write programs (the source code) into a machine language the computer can understand (assembly or machine language)
   - **(4)** The programs that perform these translations are called compilers or interpreters
   - **(5)** If a programmer wishes to translate a machine language program into a higher level language a human can understand, the programmer uses a decompiler program
   - **(6)** Programming is difficult; not only does the programmer have to detail complex logic, but the commands that comprise the program must be written in a specific syntax
   - **(7)** Syntax in this usage refers to a set of very specific rules about words, punctuation, word usage, and word order in a particular computer language
   - **(8)** Syntax must be exactly correct for a computer to correctly compile or interpret the code and run the program
   - **(9)** Problems with either the logic or the syntax will cause the program to fail, or perform incorrectly
   - **(10)** These kinds of problems are called “bugs”
   - **(11)** Correcting them is called “debugging” a program
   - **(12)** Utility programs designed to help a programmer debug a program are called debugging programs
   - **(13)** The most commonly used utility programs for programmers include programming aids and the various types of compilers and debuggers

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Applications Software

1. Includes all the various programs people use to
   - **a.** Do the work
   - **b.** Process data
   - **c.** Play games
   - **d.** Communicate with others
   - **e.** Watch videos and multimedia programs
2. Written for system users to make use of the computer
3. Application programs are written in a particular programming language then the program is “compiled” (or translated) into machine language so the computer can understand the instructions and execute the program

Teaching Tip
Provide the following example, originally, programs were written for a specific computer and could only run on that model machine. However, the science of programming languages and their translation eventually advanced to the point that programs today can generally be “ported” (or translated) across many machines. This advancement permitted programmers to develop programs that could be used on a class of machines, such as the Windows type or Mac type computers (the two are still generally incompatible). This advance opened a whole new industry, since programs could be mass marketed as off-the-shelf software packages.

4. By far the most commonly used set of programs are the programs in an office package

Discussion Tip
Ask the student to identify the most popular office packages. Ask the student to explain their choice of packages. Ask the students to identify the office packages they use and most frequently used applications.

5. Nursing applications programs are typically part of a hospital’s information system
6. Hospitals usually have a large information called a Hospital Information System (HIS) or Hospital Information Technology System (HITS)
   - **a.** These systems include most of the business applications needed, such as
      - **(1)** Billing
      - **(2)** Payroll
      - **(3)** Budget management
      - **(4)** Inventory control
      - **(5)** Personnel applications

   - **b.** They also include
     - **(1)** Clinical and semi-clinical systems
     - **(2)** The electronic medical record (EMR)
7. There are hundreds of application programs that nurses use
   - **a.** In clinical care
   - **b.** Specialized applications for all the settings of care in which nurses work

Discussion Tip
Ask the nurses to discuss the application programs, specialized applications, and the use of applications in clinical settings.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Programming Languages

1. A means of communicating with the computer
2. The only language a CPU can understand is binary or machine language
3. Binary
   - **a.** Some highly sensitive defense applications are still written in machine language
   - **b.** The language is tedious and inefficient use of human resources
   - **c.** Its programs are virtually impossible to update and debug
4. Users have longed for a machine that could accept instructions in everyday human language
5. Although that goal largely eludes programmers
6. Applications such as office support programs have become much easier to use with graphical user interface-based commands

Generation and Levels of Programming Languages

1. Machine Language
   - **a.** Machine language is the true language of the computer
   - **b.** Any program must be translated into machine language before the computer can execute it
   - **c.** The machine language
     - **(1)** Consists only of the binary numbers 1 and 0
     - **(2)** Representing one ON and OFF “switch” controlled by electrical impulses
   - **d.** Single switch is called a binary digit, and for short named a “bit”
   - **e.** All data are represented by combinations of binary digits

Teaching Tip
Give the example that eight (8) bits are required to represent a single letter or number.

   - **f.** Machine languages are machine dependent

Teaching Tip
Give the example that each model of computer has its own unique machine language.

2. Assembly Language
   - **a.** Assembly language is more like the English language
   - **b.** It is still very close to machine language
   - **c.** It is extremely obscure to the nonprogrammer

Teaching Tip
Give students the example that one (1) command in machine language is a single instruction to the processor.

   - **d.** Assembly language instructions have a one-to-one correspondence with a machine language instruction
   - **e.** Assembly language is still used by system programmers
   - **f.** Used to manipulate functions at the machine level
3. Third-Generation Language
   - **a.** Includes the procedural languages
   - **b.** Were the beginning of the second level in programming languages
   - **c.** Require the programmer to specify
     - **(1)** What the computer is to do
     - **(2)** The procedure for how to do it
   - **d.** More English-like than assembly and machine language
   - **e.** A great deal of study is required to learn to use these languages
   - **f.** The programmer must
     - **(1)** Learn the words the language recognizes
     - **(2)** Use those words in a rigid style and sequence
   - **g.** The style and sequence of a language are called its syntax

Teaching Tip
Remind students that FORTRAN and COBOL are examples of early third-generation languages.

   - **h.** A third-generation language written specifically for use in healthcare settings is MUMPS
     - **(1)** Massachusetts General Hospital Utility Multiprogramming System
     - **(2)** Was originally developed to support medical records applications at Massachusetts General
     - **(3)** Offers powerful tools to support database management systems
     - **(4)** MUMPS is now found in many different industries and hospitals
     - **(5)** Originally, MUMPS was both a language and a full operating system
     - **(6)** Today most installations load MUMPS on top of their own computer’s OS
   - **i.** Today, the most popular computer language for writing new OSs and other system programs is called C
     - **(1)** It was named after an earlier prototype program called B

- **j.** Two important late third-generation languages
  - **(1)** The visual programming languages
  - **(2)** Java
- **k.** Java was developed by Sun Microsystems to
  - **(1)** Be a relatively simple language
  - **(2)** Provide the portability and the security needed for use on a huge, public network like the Internet
- **l.** Java programming skills are critical for any serious Web developer

4. Visual Programming Languages

- **a.** Graphical user interface (GUI) technology grew and several languages were developed to facilitate program development in graphics-based environments
- **b.** Microsoft Corporation has marketed
  - **(1)** Visual BASIC (Beginners' All-purpose Symbolic Instruction Code)
  - **(2)** Visual C++
- **c.** These programs and their cousins marketed by other companies have been used for a variety of applications, especially those that allow users to interact with electronic companies through the Internet

5. Concurrent and Distributed Languages

- **a.** Originally, all programming languages were strictly sequential
- **b.** The CPU processed one line of code at a time

Teaching Tip
Provide the following examples:

A lot of calculation work and operations such as payroll and invoice processing do require each part of the process to be completed before the next is started. Mathematical and statistical calculations often must be sequential because the results of each calculation is used by the next calculation to complete the work.

- **c.** As programming addressed more complex processes, many parts of programs were not dependent on prior processes
- **d.** Different parts of the program could, at least theoretically, be processed simultaneously
- **e.** Clock speed improvements have been somewhat limited by the heat produced by faster processing
- **f.** Originally, computers had only one CPU so they had only one core processor
- **g.** As programs became more complex, and as the Internet advanced into a multimedia environment, the clock speed of a single processor could not keep up

Teaching Tip
Give the example, it is extremely slow to wait to load text while pictures are loading, but a single processor cannot do two of those actions at the same time. Those who used computers in the early 1990s may remember that Web pages with lots of images could be impossibly slow to load, and this was at least partly due to personal computers having only a single processor.

- **h.** Even though CPU clock speed increased steadily, a single processor could not keep up with the video, graphs, and sound demands of Internet pages
- **i.** According to Igor Markov, "Computer speed is not increasing anymore" (Markov, 2014)
- **j.** Another strategy was needed to improve speed
- **k.** The solution has been to add more CPU processors, and this solution is called **multiprocessing** which involves multiple processors working in parallel (parallelism)

Teaching Tip
Give the example, around the year 2000, dual core processors became available (Varela, 2013). Although they were expensive, they were essential for people who needed to run complex engineering and scientific programs, and people who liked to play complex online games with sophisticated graphics (these people are called "gamers" and their high power computers are called "gaming computers").

Teaching Tip
Give the example, the advantages of multiprocessing were such that by 2014, all personal computers advertised for the home and business had two or more processors to speed up the operation of complex and graphics intensive programs.

- **l.** A high-speed, sophisticated graphics card is also necessary to handle the volume of graphics in today's programs and Web pages
- **m.** Program languages designed to take advantage of multiple processors are called **concurrent** languages
  - **(1)** Concurrent languages are designed for programs that use multiple processors in parallel, rather than running the program sequentially on a single processor
  - **(2)** C++ is an example of a programming language designed as a concurrent language
- **n.** Closely associated with the need to run multiple parts of a program at the same time is the need to accommodate multiple users at the same time
  - **(1)** This is called ***multithreading*** (Intel, 2003)
  - **(2)** High level languages handle multiprocessing and multithreading more easily than older languages
  - **(3)** Programming languages like Java and Haskell were designed to handle both multiprocessing and multithreading

Teaching Tip
Give the example, the importance of excellent multithreading programming products was well illustrated when the Affordable Care Act government Web site could not handle the volume of users trying to access the site at the same time.

6. Fourth-Generation Languages

- **a.** Are specialized application programs that require more involvement of the user in directing the program to do the necessary work

- **b.** Some people in the computer industry do not consider these to be programming languages
- **c.** Procedural languages include programs such as
  - **(1)** Spreadsheets
  - **(2)** Statistical analysis programs
  - **(3)** Database query languages
- **d.** These programs may also be thought of as applications programs for special work functions
- **e.** The difference between these languages and the earlier generation languages is that the user specifies what the program is to do, but not how the program is to perform the task
- **f.** The "how" is already programmed by the manufacturer of the language/applications program

Teaching Tip

Give the example, to perform a chi-square calculation in FORTRAN, the user must specify each step involved in carrying out the formula for a chi-square and also must enter into the FORTRAN program all the data on which the operations are to be performed. In Statistical Package for Social Sciences (SPSS), a statistical analysis program, the user enters a command (from a menu of commands) that tells the computer to compute a chi-square statistic on a particular set of numbers provided to the program. That is, the user provides SPSS with a data file and selects the command that executes a Chi-Square on the selected data. But the user does not have to write code telling the computer which mathematical processes (add, subtract, multiply, divide) to perform on the data in order to calculate the statistic. The formula for chi-square is already part of the SPSS program.

- **g.** An important Fourth-Generation language is SQL (for Structured Query Language)
  - **(1)** It is a language designed for management and query operations on a relational database
  - **(2)** It does far more than simply allow users to query a database
  - **(3)** It also supports data insert, data definition, creating of the database schema, update and delete, and data modification
  - **(4)** It is not particularly user friendly for nonprogrammers
  - **(5)** It is an extremely powerful language for information retrieval

7. Fifth-Generation Languages

- **a.** Third-level languages are called natural languages
- **b.** The user tells the machine what to do in the user's own natural language or through use of a set of very English-like commands
- **c.** Voice recognition technology is integrated with the language so that voice commands are recognized and executed
- **d.** Natural language systems are clearly in the future of personal computing
  - **(1)** The great difficulty is how to reliably translate natural, spoken human language into a language the computer can understand
  - **(2)** To prepare a translation program for a natural language requires several levels of analysis
  - **(4)** First, the sentences need to be broken down to identify the subject's words and relate them to the underlying constituents of speech (i.e., parsed)
  - **(5)** The next level is called semantic analysis, whereby the grammar of each word in the sentence is analyzed
  - **(6)** It attempts to recognize the action described and the object of the action
- **f.** There are several computer programs that translate natural languages based on basic rules of English
  - **(1)** They generally are specially written programs designed to interact with databases on a specific topic
  - **(2)** By limiting the programs to querying the database, it is possible to process the natural language terms
- **g.** An application of natural language processing (NLP) is called biomedical text mining (BioNLP)
  - **(1)** The purpose is to assist users to find information about a specific topic in biomedical literature
  - **(2)** This method of searching professional literature articles in PubMed or another database increases the likelihood that a relevant mention of the topic will be discovered and extracted
  - **(3)** This increases the probability of a comprehensive information extraction process
  - **(4)** One example is a program called DNorm
  - **(5)** DNorm detects specific disease names (entered by the searcher) in journal articles or other text documents
  - **(6)** It associates them with search terms in MeSH terms in PubMed and terms in SNOMED-CT[1] (Leaman, Dogan, & Zhivong, 2014)

8. Text Formatting Languages

- **a.** Text formatters are not true programming languages
- **b.** They are used to format content, originally text, for visual display in a system
- **c.** The skills required to learn to format text are similar to the skills required to learn a programming language
- **d.** Informally they are called programming languages
- **e.** The most famous is HyperText Markup Language (HTML)
- **f.** HTML is used to format text for the WWW and is one of the older formatting languages
- **g.** These languages specify to the computer how text and graphics are to be displayed on the computer screen
- **h.** There are many other formatting languages, such as Extensible Markup Language (XML) which is a restricted version of SGML and used in most word processing programs

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[1] SNOMED CT is a database containing a comprehensive list of clinical terms. Nursing terms from all the major nursing terminologies have been listed in SNOMED CT. It is owned, maintained, and distributed by the International Health Terminology Standards Development Organisation (IHTSDO).

  - **i.** The original markup language is Standardized General Markup Language (SGML) which is actually a meta language and the standard for markup languages
  - **j.** HTML and XML adhere to the SGML pattern

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Common Software Packages for Microcomputers

1. The most common package sold with computers is a standard office package
   - **a.** The standard office package includes a
     - **(1)** Word processing program
     - **(2)** Spreadsheet program
     - **(3)** Presentation graphics program
   - **b.** The upgraded or professional versions usually add
     - **(1)** Some form of database management system
     - **(2)** An e-mail system
     - **(3)** A "publisher" program
   - **c.** The two most commonly used programs are the
     - **(1)** E-mail system
     - **(2)** Word processor

Teaching Tip
Provide the example, In fact, some people purchase a computer with only an OS, word processor, and an Internet browser, and sign up for their e-mail account and use little else.

   - **d.** Most of these common programs have to be written in two versions
     - **(1)** IBM PC platform
     - **(2)** Mac
   - **e.** Software packages are sold
     - **(1)** On DVDs or flash drives
     - **(2)** Many software companies are marketing their products through the Internet
   - **f.** Security programs are also an important market product
     - **(1)** A large number of people seek to steal identities
     - **(2)** Use the computer for criminal or malicious activity
     - **(3)** Every user who accesses the Internet should have security software

Software Package Ownership Rights

1. Protecting ownership rights in software has presented a challenge to the computer software industry
2. A program sold to one customer can be installed on a very large number of machines
3. This practice obviously seriously harms the profitability of software development
4. If programs were sold outright
   - **a.** Users would have every right to distribute them as they wished
   - **b.** The industry could not survive in such market conditions
5. As a result, the software industry has followed an ownership model more similar to that of the book publishing industry than to the model used by vendors of most commercial products

Teaching Tip
Provide the example, when most commercial products like furniture or appliances are sold, the buyer can use the product or resell it or loan it to a friend if so desired. The product sold is a physical product that can be used only by one customer at a time. Copying the product is not feasible. However, intellectual property is quite a different proposition: what is sold is the idea. The medium on which the idea is stored is not the product.

Teaching Tip
Provide the example, when the PC industry was new, people buying software viewed their purchase as the physical diskette on which the intellectual property was stored. Software was expensive, but the diskettes were cheap. Therefore, groups of friends would often pool money to purchase one copy of the software and make copies for everyone in the group. This, of course, enraged the software vendors.

As a result, copyright laws were extended to software so that only the original purchaser was legally empowered to install the program on his or her computer. Any other installations were considered illegal copies, and such copies were called pirate copies.

6. Purchasers of software do not buy full rights to the software
   - **a.** They purchase only a license to use the software
   - **b.** Individually purchased software is licensed to one and only one computer
   - **c.** An exception can be made if the individual has both a desktop and a laptop
   - **d.** Fair use allows the purchaser to install the software on all the machines he or she personally owns
   - **e.** Companies that have multiple computers that are used by many employees must purchase a separate copy for each machine, or more typically, they purchase a "site license."

Teaching Tip
Provide the following example, a site license is a way of buying in bulk, so to speak. The company and software vendor agree on how many machines the software may be used on, and a special fee is paid for the number of copies to be used. Additional machines over the number agreed on require an increase in the allowable sites—and payment of the higher site license fee—or separate copies of the software may be purchased. What is not permitted, and is, in fact, a form of theft is to install more copies of the software than were paid for.

Discussion Point
Ask the student to discuss rights to software. What alternatives would they suggest to fair use and site licenses?

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Common Software Useful to Nurses

1. In most hospitals, most software systems used by nurses are based in a HIS
   a. The HIS is a multipurpose program, designed to support many applications in hospitals and their associated clinics
   b. The components nurses use most include
      (1) The electronic medical record
      (2) Admission-discharge-transfer (ADT) systems
      (3) Medication administration record (MAR) software
      (4) Supplies inventory systems
      (5) Laboratory systems
      (6) Radiology system
      (7) Computerized patient acuity system
      (8) E-mail system

Teaching Tip
Provide the following example, there are systems for physicians to document their medical orders; quality and safety groups such as the Leapfrog group consider a computer physician order entry (CPOE) system to be so important that they list it as a separate item on their quality checklist.

2. Nurses are finding that they are able to build regional, national, and international networks with their nursing colleagues with the use of
   a. Chat rooms
   b. Bulletin boards
   c. Conferencing systems
   d. Distservs on the Internet
3. Nurses may download any of thousands of software applications (apps) onto their personal digital assistant (PDA) to assist them with patient care
   a. Most are very low cost and some are free
   b. Such programs include
      (1) Drug guides
      (2) Medical dictionaries
      (3) Consult guides for a variety of patient populations and clinical problems
   c. Software can now be downloaded onto a PDA to
      (1) Measure heart and respiratory rate
      (2) Perform ultrasounds on various organs
      (3) Test hearing
      (4) Perform a simple EKG
      (5) Other physical assessments
4. As so many items of healthcare equipment have computer processers today, the nurse may not always realize that software is being used

Teaching Tip
Provide the following examples**,** volumetric pumps control IV flow through computer processors. Heart monitors and EKG and EEG machines all have internal computers that detect patterns and provide interpretations of the patterns. Hospital beds may have processors to detect wetness, heat, weight, and other measures. Most radiology equipment today is computer based. Many items of surgery equipment exist only because computer processors are available to make them operate.

5. Some nursing applications include a handy “dashboard”
   a. Which is an application that provides a sort of a menu of options from which the nurse can choose
   b. Typically, dashboards provide the nurse a quick way to order common output from certain (or all) screens
   c. May provide some kind of alert that a task is due to be performed

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Computer Systems

1. Every functioning computer is a system
2. It is a complex entity
3. Consists of an organized set of interconnected components or factors that function together as a unit to accomplish results that one part alone could not
4. Computer system may refer to a single machine (and its peripherals and software) that is unconnected to any other computer

Teaching Tip
Provide the example that most healthcare professionals use computer systems consisting of multiple, interconnected computers that function to facilitate the work of groups of providers and their support people in a system called a **network**.

5. The greatest range of functionality is realized when computers are connected to other computers in a network or, as with the Internet, a system of networks in which any computer can communicate with any other computer.
6. Common types of computer networks are
   a. Point to point
   b. Local area network (LAN)
   c. Wide area network (WAN)
   d. Metropolitan area networks (MAN)

Teaching Tip
Provide the example, a point-to-point network is a very small network in which all parts of the system are directly connected via wires or wireless (typically provided by a router in a single building).

7. LANs, WANs, and MANs are sequentially larger and given the number of users, they require communications architecture to ensure all users on the network are served
8. If the network capacity is too small, some users will experience very long waits or perhaps the system will crash from overload
9. Computer networks must allocate time and memory space to many users, and so must have a way to organize usage of the network resources so that all users are served
10. There are a variety of allocation strategies for high-level communication in networks
    a. The most common are token ring (developed by IBM)
    b. Star (also called multipoint; all communications go through a single hub computer)
    c. Bus (in which all computers are connected to a single line)
    d. Tree
    e. For very large networks, backbone communication technology is increasingly used
11. The use of systems in computer technology is based on system theory
    a. System theory and its subset, network theory, provide the basis for understanding how the power of individual computers has been greatly enhanced through the process of linking multiple computers into a single system and multiple computer systems into networks

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Information Science

1. It is an interdisciplinary field
2. Primarily concerned with the
    a. Analysis
    b. Collection
    c. Classification
    d. Manipulation
    e. Storage
    f. Retrieval
    g. Movement
    h. Dissemination
    i. Use of information
3. It is concerned with
    a. Technologies
    b. Strategies
    c. Methodologies for getting the right information to people when it is needed without people getting overwhelmed with irrelevant and unwanted information
4. All science is concerned with
    a. Measurement
    b. Analysis
5. Information science is no different
6. Key themes in information science analysis include
    a. Optimality
    b. Performance
    c. Complexity
    d. Structure
7. Optimality varies with the situation
    a. Generally refers to achieving an optimum value for some desired outcome

Teaching Tip
Provide the example, when a nurse wants to obtain information on outcomes of patients who suffered a complication for the purpose of determining whether they were rescued or not, the optimal outcome is that the search facility in the information system finds all patient records for patients who were truly at risk, and does not miss any. Additionally, the system retrieves few if any records of patients who did not suffer a high-risk complication. Optimality may refer to almost any variable that is measured on a numerical scale, such as cost, time (e.g., time to answer patient call lights), workload, etc.

8. Performance is typically considered in the context of average performance of the information system over a series of communication instances
9. Averages are better representations of performance than long lists of single instance performance

Teaching Tip
For example, the average time it takes an e-mail to reach the intended recipient is much more useful than a long list of each e-mail and its transmission time

10. Complexity is a reality with the enormous masses of data and information generated, collected, stored, and retrieved
    a. A typical measure of complexity in informatics is the amount of time it takes to complete a task
    b. The time required is most often a function of the amount of information that must be dealt with to complete the task
11. Structure means developing a system for
    a. Ordering
    b. Cataloging the data and information, particularly in a database
12. Excellent structure serves to reduce the amount of time required to perform operations on the database, such as
    a. Search
    b. Retrieve
    c. Update
    d. Sort

13. When data are well structured and cataloged in a database
    a. Complexity can actually be reduced because the system will not have to review all the data to find particular items
14. Rather, it will have to search only the sectors in which the data are going to be found, and the structure tells the programs that operate on the database which sectors to search.
15. Information science is a rapidly growing field
16. Much of the progress is based on development and testing of mathematic algorithms related to information management tasks, such as
    a. Storage and retrieval
    b. Database structure
    c. Measuring the value of information
    d. Other work involved in increasing the efficiency of using information to make better decisions
17. In nursing, some key issues include ways nurses use information to make better nursing diagnoses and care decisions
18. Nursing information science is very concerned with measuring patient care outcomes and what nursing protocols produce the best outcomes
19. Information science is only beginning to help people put the vast amount of data stored in multiple databases to work in efforts to improve health
20. In the future, data mining and other technologies designed to harvest information from very large databases
    a. It is likely to become a major focus of health research
    b. Holds great promise for improving healthcare by providing accurate information to decision-makers

SUMMARY

The chapter concludes by giving emphasis to the following

- Software is the set of commands to the computer that instruct the system as to what the user wants done
- Software is the general term that describes the computer instruction code, and particular items of software are called programs
- The three general types of software are
  - Systems software
  - Utility software
  - Applications programs
- Systems software controls the operations of the machine and how it works peripheral equipment and supports utility and applications programs
- Utility software supports the efficiency, productivity, and security of the systems software and applications programs
- Applications software includes all the programs the user employs to do the work for which the user got the computer
- Examples of these types of software include operating systems for systems software, antivirus programs for utility software, and word processing for applications software
- A computer cannot naturally "understand" human language
- The language of the computer is machine language which consists of a series of zeros and ones (0, 1) that represents an on/off switch
- One switch is a binary digit and called a "bit"
- Eight bits taken together are needed to represent a single letter or number to a user
- Machine language is understandably very difficult for programmers
- More English-like languages have been developed to facilitate programming
- As languages become more like English, they are described in terms of levels, and the higher the level, the more English-like the language
- Machine language is the lowest level
- Languages are also described by generations, and machine language is the first generation
- The first level includes the first two generations of programming languages:
  - Machine language
  - Assembly language
- The second level includes the third and fourth generations:
  - High-level procedural
  - Nonprocedural languages
- The third level (and fifth generation) is natural language
- The various languages allow programmers to develop programs to meet many needs of both the workplace and personal users
- For nurses, there are a large number of programs available in many workplaces to support
  - Charting
  - Interpreting waveforms such as heart rhythms and breathing rhythms
  - Controlling intravenous drip rates
  - Calculating drug dosages
  - Many other work functions
- There are literally thousands of programs for personal data assistants (PDAs) for work and personal enjoyment
- Every day, more medically directed applications are available to download onto one's smartphone
- There are literally thousands of games too
- Computing and software have become pervasive in nurses lives, and are tools that nurses use every day to provide high quality nursing care services

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the learning objectives

- Identify the three categories of software and their functions
- Describe four important analytic themes in Information Science

- Explain five types of programming languages and their general capabilities
- Discuss PDA applications that can be used as part of physical assessment
- Explain the differences among LANs, WANs, and MANs

CHAPTER REVIEW QUESTIONS

Question 4.1: Which statement(s) best describe(s) Software?

a. Term that applies to the computer equipment
b. Term that applies to the instructions that directs the computer's work
c. Term that represents physical components
d. Terms that handles CPU and peripherals

Question 4.2: What are the three categories of software?

a. Utility, System, and Safety
b. Application, Safety, and Security
c. System, Utility, and Application
d. Safety, Application, and System

Question 4.3: What are the levels/tasks that the System Software controls?

a. Basic Input/Output System, Operating System, and Management of Storage
b. Firmware, Operating System, and Basic Input/Output System
c. RAM, Operation System, and Basic Input/Output System
d. Management of Storage, RAM, and Operating System

Question 4.4: What is the purpose of the Operating System?

a. Handles only communication with peripherals
b. Overall controller of all computer work
c. Allocates data to the CPU
d. Represents the hardware architecture

Question 4.5: Name at least four of the six major tasks that the Utility Software controls?

a. Data Backup, Monitor Storage, Select Programming Language, and Defragment Disk
b. Security Software, Disk Management Utility, Data Backup, and Archival Software
c. Defragment Disk, Data Backup, Monitor Screen, and Antivirus Protection
d. Data Backup, Monitor Screen, Monitor Storage, and Defragment Disk

Question 4.6: What are the major tasks of the Applications Software?

a. Computer programs written to only play games
b. Computer programs are used to secure the computer data
c. Computer programs written to make the computer function for users
d. Computer programs written in machine language

Question 4.7: What are only Programming languages?

a. Assembly, HTML, and HL7
b. SQL, Fortran, and Assembly
c. COBOL, Fortran, and CPU
d. Machine, HL7, and Assembly

Question 4.8: What are the characteristics of the different Generations of Programming languages?

a. Natural Language consists of English-like commands and represents Fifth-Generation Language. True ___ False ___
b. Machine Language consists of binary digits and represents Fourth Generation Language. True ___ False ___
c. Procedural Language represents Third-Generation Languages such as MUMPS. True ___ False ___
d. Fourth Generation Languages are specialized application programs. True ___ False ___
e. Assembler Language consists of English-like words and represents Fourth-Generation Language. True ___ False ___

Question 4.9: What are some HIS applications that are useful to nurses?

a. EHR, ADT, and CPU
b. ADT, MAR, and CPOE
c. MAR, CPU, and HL7
d. Acuity, HL7, and ADT

Question 4.10: Describe and/or define what is a computer system.

a. It is a system of interrelated components that function together
b. It is a subset with multiple networks
c. It is technology that reads bar coding
d. It is a network that is based on systems theory

ANSWERS AND EXPLANATIONS

Question 4.1: (b) Term that applies to the instructions that directs the computer's work. It directs the computer's hardware by communicating electronically instructions in order to translate instructions created in human language into machine language. Software is supplied as an organized set of instructions called programs or a set of programs called a package.

Question 4.2: (c) System, Utility, and Application. System software "boots" (starts up and initializes) the computer; controls input, output, and storage; and controls the operations of the applications software. Utility software consists of programs designed to support and optimize the functioning of the computer system. Application software includes the various programs that users require to perform day-to-day tasks. They support the actual work of the user.

Question 4.3: (a) Basic Input/Output System, Operating System, and Management of Storage. System software consists of a variety of programs that control the individual computer and makes the user's applications programs work well with the hardware. It also helps speed up the computer processing and manages efficiently other management tasks.

Question 4.4: (b) Overall controller of all computer work. The Operating System (OS) is the overall controller of the work of the computer. It is loaded from the hard drive into RAM as soon as the computer is turned on. Another critical task is the management of storage.

Question 4.5: (b) Security Software, Disk Management Utility, Data Backup, and Archival Software. Utility software include programs designed to keep the computer system operating efficiently. They add power to the functioning of the system software, support the OS, and applications software programs.

Question 4.6: (c) Computer programs written to make the computer function for users. Applications programs includes all of the various programs people use to do work, process data, play games, communicate with others, and watch videos and multimedia programs on a computer.

Question 4.7: (b) SQL, Fortran, and Assembly. A programming language is a means of communicating with the computer since the only language the CPU understands in binary or machine language.

Question 4.8:

- **a.** True
- **b.** False
- **c.** True
- **d.** True
- **e.** False

Question 4.9: (b) ADT, MAR, and CPOE. The HIS is a multipurpose program designed to support many applications in hospitals or related clinics. The components nurses use most have been identified as admission-discharge-transfer (ADT) systems; medication administration record (MAR) software, and CPOE systems used by physicians to enter orders that nurses have to address.

Question 4.10: (a) It is a system of interrelated components that function together. It is a complex entity, consisting of organized set of interconnected components that function together as a unit to accomplish results that one part alone could not. Every functioning computer is a system. Computer system may refer to a single stand-alone machine, or multiple interconnecting computers that support a network.

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5

Open Source and Free Software

• OBJECTIVES

1. Describe the basic concepts of open source software (OSS) and free software (FS).
2. Describe the differences between open source software, free software, and Proprietary software, particularly in respect of licensing.
3. Discuss why an understanding of open source and free software is important in a healthcare context, in particular where a choice between proprietary and open source software or free software is being considered.
4. Describe some of the open source and free software applications currently available, both healthcare-specific and for general office/productivity use.
5. Introduce some of the organizations and resources available to assist the nurse interested in exploring the potential of open source software.
6. Create and develop an example of OSS.
7. Describe the organization of health databases.
8. Use Boolean Logic to form query conditions.
9. Understand methods for querying and reporting from databases (VistA FileMan, SQL).

• KEY WORDS

Querying databases
Boolean Logic
Open source software
Free software
Linux

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of freeware? Do you use any freeware? Do you use any open source software? Have you used a computer with Linux as the operating system? What was your experience in using Linux? Have you used VistA in the clinical setting? Have you used OpenOffice? What was your experience?

For a WIIFM statement, say to the class, "Many nurses have only a vague understanding of what OSS/FS are and their possible applications and relevance to nursing and NI." This chapter will provide an overview of the background to OSS/FS, explaining the differences and similarities between open source and free software, and introducing some particular applications such as the GNU/Linux operating system. Licensing will be addressed, as it is one of the major issues that exercises the minds of those with responsibility for decision making, as issues such as the interface of OSS/FS and proprietary software, or use of OSS/FS components are not fully resolved. Some commonly available and healthcare-specific applications will be introduced, with a few examples being discussed. Some of the organizations working to explore the use of OSS/FS within healthcare and nursing, and some additional resources, will be introduced.

The chapter will conclude with a case study of what many consider the potential "mother of OSS/FS healthcare applications," Veterans Health Information System and Technology Architecture (VistA), and recent moves to develop fully OSS/FS versions." As a nurse, it is important to understand OSS/FS and their possible applications and relevance to nursing and NI.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Review Web sites for more information regarding VistA or OpenMRS
3. Review OSS/FS Web sites for more information
4. Review the OpenOffice Web site for more information

Timing

1. Lecture 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

OSS/FS—The Theory OSS/FS

1. The term *open source* (and the acronym OSS/FS) in this chapter is used loosely (and, some would argue, incorrectly) to cover several concepts, including
    a. Open source software
    b. Free software
    c. GNU/Linux
2. Each of these concepts and applications has its own definition and attributes
3. There are 2 major philosophies in the OSS/FS world,
    a. the free software foundation (FSF) philosophy
    b. the open source initiative (OSI) philosophy,
    c. today they are often seen as separate movements with different views and goals,
    d. their adherents frequently work together on specific practical projects
4. The key commonality between FSF and OSI philosophies is that the source code is made available to the users by the programmer
5. Where FSF and OSI differ is in the restrictions placed on redistributed source code
6. FSF is committed to no restrictions
    a. You are not allowed to place any restrictions on the openness of the resultant source code
7. The difference between the two movements is said to be
    a. That the free software movement's fundamental issues are ethical and philosophical
    b. While for the open source movement, the issues are more practical than ethical ones
    c. The FSF asserts that open source is a development methodology
    d. Free software is a social movement
8. OSS/FS is contrasted with proprietary or commercial software
9. Proprietary software is that
    a. On which an individual or company holds the exclusive copyright
    b. At the same time restricting other people's access to the software's source code and/or the right to copy, modify, and study the software
10. Commercial software is software developed by businesses or individuals with the aim of making money from its licensing and use
    a. Most commercial software is proprietary
    b. There is commercial free software
11. There is noncommercial, nonfree software
12. OSS/FS should also not be confused with freeware or shareware
13. Freeware is software offered free of charge, but without the freedom to modify the source code and redistribute the changes, so it is not free software (as defined by the FSF)
14. Shareware is another form of commercial software, which is offered on a "try before you buy" basis
    a. If the customer continues to use the product after a short trial period, or wishes to use additional features they are required to pay a specified, usually nominal, license fee

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Free Software Definition

1. *Free software* is defined by the FSF in terms of four freedoms for software users
    a. To have the freedom to use
    b. Study
    c. Redistribute
    d. Improve the software
2. A program is only free software, in terms of the FSF definition, if users have all of these freedoms
3. The FSF believes that users should be free to redistribute copies
    a. Either with or without modifications
    b. Either gratis or through charging a fee for distribution, to anyone, anywhere without a need to ask or pay for permission to do so
4. Confusion around the use and meaning of the term *free software* arises from the multiple meanings of the word *free* in the English language
5. In other languages, there is less of a problem, with different words being used for the "freedom" versus "no cost" meanings of *free*

Teaching Tip
Provide the following example, the French terms *libre* (freedom) software versus *gratis* (zero price) software.

6. The "free" of free software is defined in terms of
    a. Liberty, not price
    b. To understand the concept, the common distinction is in thinking of free as in free speech, not as in free beer
7. Acronyms such as FLOSS (free/libre/OSS—a combination of the above two terms
    a. Emphasizing the "Libre" meaning of the word *free*)
8. OSS/FS are increasingly used, particularly in Europe, to overcome this issue

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Discussion Point
Ask the students to describe their experiences using shareware and freeware.

Open Source Software Definition

1. Open source software is any software satisfying the open software initiative's definition
2. The open source concept is said
    a. To promote software reliability and quality by supporting independent peer review
    b. Rapid evolution of source code
    c. As well as making the source code of software freely available
3. Provides free access to the programmer's instructions to the computer in the programming language in which they were written
4. Many versions of open source licenses allow anyone to modify and redistribute the software
5. The open source initiative (OSI) has created a certification mark, "OSI certified"
6. In order to be OSI certified, the software must be distributed under a license that guarantees the right to
    a. Read
    b. Redistribute
    c. Modify
    d. Use the software freely
7. The source code must be accessible to all
8. The distribution terms must comply with 10 criteria defined by the OSI

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

OSS/FS Development Models and Systems

1. OSS/FS has existed as a model for developing computer applications and software since the 1950s
2. At that time, software was often provided free (gratis), and freely, when buying hardware
3. The freedoms embodied within OSS/FS were understood as routine until the early 1980s with the rise of proprietary software
4. It was in the 1980s that the term free software as we recognize them today, came into existence to distinguish it from the proprietary models
5. In the 1990s the term open source software, as we recognize it today, came into existence to distinguish it from the proprietary model
6. The development models of OSS/FS are said to contribute to their distinctions from proprietary software
7. Shaw et al. state that as OSS/FS is "developed and disseminated in an open forum," it "revolutionizes the way in which software has historically been developed and distributed"
8. A United Kingdom government report emphasizes the open publishing of source code and that development is often largely through voluntary efforts
9. While OSS/FS is often described as being developed by voluntary efforts, this description may belie the professional skills and expertise of many of the developers
10. Many of those providing the volunteer efforts are highly skilled programmers who contribute time and efforts freely to the development of OSS/FS
11. Many OSS/FS applications are coordinated through formal groups

Teaching Tip
Provide the following for example, the Apache Software Foundation (www.apache.org) coordinates development of the Apache hypertext transfer protocol (HTTP) server and many other products.

12. OSS/FS draws much of its strength from the collaborative efforts of people
    a. Who work to improve, modify, or customize programs
    b. Believing they must give back to the OSS/FS community so others can benefit from their work
13. The OSS/FS development model is unique
    a. It bears strong similarities to the openness of the scientific method
    b. It is facilitated by the communication capabilities of the Internet that allows collaboration and rapid sharing of developments
    c. Such that new versions of software can often be made available on a daily basis
14. The most well-known description of the distinction between OSS/FS and proprietary models of software development lies in Eric Raymond's famous essay, "The Cathedral and the Bazaar"

Teaching Tip
Provide the following example, Cathedrals, Raymond says, were built by small groups of skilled workers and craftsmen to carefully worked out designs. The work was often done in isolation, and with everything built in a single effort with little subsequent modification. Much software, in particular proprietary software, has traditionally been built in a similar fashion, with groups of programmers working to strictly controlled planning and management, until their work was completed and the program released to the world.

15. In contrast, OSS/FS development is likened to a bazaar, growing organically from an initial small group of traders or enthusiasts establishing their structures and beginning businesses

Teaching Tip
Provide the following example, the bazaar grows in a seemingly chaotic fashion, from a minimally functional structure, with later additions or modifications as circumstances dictate.

16. Likewise, most OSS/FS development
    a. Starts off highly unstructured, with developers releasing early, minimally functional code
    b. Then modifying their programs based on feedback
    c. Other developers may then join, and modify or build on the existing code; over time, an entire operating system and suite of applications develops, evolves, and improves continuously
17. The bazaar method of development is said to have been proven over time to have several advantages, including the following:
    a. Reduced duplication of efforts through being able to examine the work of others and through the potential for large numbers of contributors to use their skills
    b. As Moody describes it, there is no need to reinvent the wheel every time as there would be with commercial products whose codes cannot be used in these ways
    c. Building on the work of others, often by the use of open standards or components from other applications
    d. Better quality control; with many developers working on a project, code errors (bugs) are uncovered quickly and may be fixed even more rapidly (often termed Linus' Law, "given enough eyeballs, all bugs are shallow"
    e. Reduction in maintenance costs; costs, as well as effort, can be shared among potentially thousands of developers

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Choosing OSS/FS or Not

1. Proposed benefits of OSS/FS
    a. OSS/FS has been described as the electronic equivalent of generic drugs
    b. In the same way as the formulas for generic drugs are made public, so OSS/FS source code is accessible to the user
    c. Any person can see how the software works and can make changes to the functionality
    d. It is suggested by many that there are significant similarities between the open source ethos and the traditional scientific method approach
    e. As this latter method is based on
        (1) Openness
        (2) Free sharing of information
        (3) Improvement of the end result
    f. As OSS/FS can be obtained royalty free
    g. It is less expensive to acquire than proprietary alternatives
    h. This means that OSS/FS can transform healthcare in developing countries just as the availability of generic drugs have
    i. This is only one of several benefits proposed for OSS/FS, with further benefits
        (1) Including lack of the proprietary lock-in that can often freeze out innovation
        (2) With OSS/FS projects supporting open standards and providing a level playing field
        (3) Expanding the market by giving software consumers greater choice
    j. There are many other reasons why public and private organizations are adopting OSS/FS, including
        (1) Security
        (2) Reliability and stability
        (3) Developing local software capacity
    k. Many of these proposed benefits have yet to be demonstrated or tested extensively
    l. There is growing evidence for many of them
2. Issues in OSS/FS
    a. The issues include
        (1) Licensing
        (2) Copyright and intellectual property
        (3) Total cost of ownership (TCO)
        (4) Support and migration
        (5) Business models
        (6) Security and stability
    b. Total cost of ownership
        (1) TCO is the sum of all the expenses directly related to the ownership and use of a product over a given period of time
        (2) The popular myth surrounding OSS/FS is that it is always free as in free of charge

Teaching Tip
Provide the example, Ubuntu, Red Hat, SuSE, and Debian can be obtained at no charge from the Internet; however, copies can also be sold.

        (3) No true OSS/FS application charges a licensing fee for usage, thus on a licensing cost basis OSS/FS applications are almost always cheaper than proprietary software

- **(4)** However, licensing costs are not the only costs of a software package or infrastructure
- **(5)** It is also necessary to consider personnel costs, hardware requirements, migration time, changes in staff efficiency, and training costs, among others
- **(6)** Without all of this information, it is impossible to really know which software solutions are going to be the most cost effective
- **(7)** There are still real costs with OSS/FS, specifically around configuration and support
- **(8)** Wheeler lists the main reasons why OSS/FS is generally less expensive, including the following
  - **i.** OSS/FS costs less to initially acquire, because there are no license fees
  - **ii.** Upgrade and maintenance costs are typically far less due to improved stability and security
  - **iii.** OSS/FS can often use older hardware more efficiently than proprietary systems, yielding smaller hardware costs and sometimes eliminating the need for new hardware
  - **iv.** Increasing numbers of case studies using OSS/FS show it to be especially cheaper in server environments

c. Support and migration

- **(1)** Making an organization-wide change from proprietary software can be costly
- **(2)** Sometimes the costs will outweigh the benefits
- **(3)** Some OSS/FS packages do not have the same level of documentation, training, and support resources as their common proprietary equivalents
- **(4)** May not fully interface with other proprietary software being used by other organizations with which an organization may work (e.g., patient data exchange between different healthcare provider systems)
- **(5)** Migrating from one platform to another should be handled using a careful and phased approach

Teaching Tip

Provide the example, the European Commission has published a document entitled the "IDA Open Source Migration Guidelines" (European Communities, 2003) that provides detailed suggestions on how to approach migration. These include the need for a clear understanding of the reasons to migrate, ensuring that there is active support for the change from IT staff and users, building up expertise and relationships with the open source movement, starting with noncritical systems, and ensuring that each step in the migration is manageable.

d. Security and stability

- **(1)** There is no perfectly secure operating system or platform
- **(2)** Factors such as development method, program architecture, and target market can greatly affect the security of a system and consequently make it easier or more difficult to breach
- **(3)** There are some indications that OSS/FS systems are superior to proprietary systems in this respect
- **(4)** The security aspect has already encouraged many public organizations to switch or to consider switching to OSS/FS solutions

Teaching Tip

Provide the example, the French Customs and Indirect Taxation authority, for example, migrated to Red Hat Linux largely because of security concerns with proprietary software.

- **(5)** Among reasons often cited for the better security record in OSS/FS is the availability of the source code (making it easier for vulnerabilities to be discovered and fixed)
- **(6)** Many OSS/FS have a proactive security focus, so that before features are added, the security considerations are accounted for and a feature is added only if it is determined not to compromise system security
- **(7)** In addition, the strong security and permission structure inherent in OSS/FS applications that are based on the Unix model are designed to minimize the possibility of users being able to compromise systems
- **(8)** OSS/FS systems are well known for their stability and reliability
- **(9)** Many anecdotal stories exist of OSS/FS servers functioning for years without requiring maintenance
- **(10)** Quantitative studies are more difficult to come by
- **(11)** Security of information is vitally important in the health domain
- **(12)** The advocates of OSS/FS suggest that it can provide increased security over proprietary software
- **(13)** A report to the UK government saw no security disadvantage in the use of OSS/FS products

Teaching Tip

Provide the example, US government's National Security Agency (NSA), according to the same report, supports a number of OSS/FS security-related projects. Stanco considers that the reason the NSA thinks that free software can be more secure is that when anyone and everyone can inspect source code, hiding backdoors into the code can be very difficult.

- **(14)** In considering a migration to OSS/FS, whether it is for everyday office and productivity uses, or for health-specific applications, there are some commonly encountered challenges that one may face
- **(15)** These challenges have traditionally been seen as including the following
  - **i.** There is a relative lack of mature OSS/FS desktop applications
  - **ii.** Many OSS/FS tools are not user-friendly and have a steep learning curve
  - **iii.** File sharing between OSS/FS and proprietary applications can be difficult
- **(16)** As OSS/FS applications have matured in recent years, and the user community grown, many of these challenges have been largely overcome
- **(17)** Many OSS/FA applications are indistinguishable from proprietary equivalents for many users in terms of functionality, ease of use, and general user-friendliness

   e. Choosing the Right Software: The Three-Step Method for OSS/FS Decision Making
      (1) Step 1. Define the needs and constraints

Teaching Tip

Provide the following information, must be clearly defined, including those of the organization and of individual users. Other specific issues to consider include range of features, languages, budget (e.g., for training or integration with other systems), the implementation time frame, compatibility with existing systems, and the skills existing within the organization.

      (2) Step 2. Identify the options

Teaching Tip

Provide the following information, a short list of three to five software packages that are likely to meet the needs can be developed from comparing software packages with the needs and constraints listed in the previous phase. There are numerous sources of information on OSS/FS packages, including recommendations of existing users, reviews, and directories (e.g., OSDir.com and OpenSourceCMS.com.) and software package sites that contain promotional information, documentation, and often demonstration versions that will help with the review process.

      (3) Step 3. Undertake a detailed review

Teaching Tip

Once the options have been identified, the final step is to review and choose a software package from the short list. The aim here is to assess which of the possible options will be best for the organization. This assessment can be done by rating each package against a list of criteria, including quality, ease of use, ease of migration, software stability, compatibility with other systems being used, flexibility and customizability, user response, organizational buy-in, evidence of widespread use of the software, and the existence of support mechanisms for the software's use. Hands-on testing is key and each piece of software should be installed and tested for quality, stability, and compatibility, including by a group of key users so as to assess factors such as ease of use, ease of migration, and user response.

   f. Making a decision
      (1) Once the review has been completed, if two packages are close in score
      (2) Intuition about the right package is probably more important than the actual numbers in reaching a final decision

Teaching Tip

Provide the following examples:

Examples of Adoption or Policy Regarding OSS/FS.

OSS/FS has moved beyond the closed world of programmers and enthusiasts. Governments around the world have begun to take notice of OSS/FS and have launched initiatives to explore the proposed benefits. There is a significant trend toward incorporating OSS/FS into procurement and development policies, and there are increasing numbers of cases of OSS/FS recognition, explicit policy statements, and procurement decisions. Many countries, regions, and authorities now have existing or proposed laws mandating or encouraging the use of OSS/FS.

A survey from The MITRE Corporation showed that the US Department of Defense (DoD) at that time used over 100 different OSS/FS applications. The main conclusion of their study was that OSS/FS software was used in critical roles, including infrastructure support, software development, research, and that the degree of dependence on OSS/FS for security was unexpected. In 2000, the (US) President's Information Technology Advisory Committee recommended that the US federal government should encourage OSS/FS use for software development for high-end computing. In 2002, the UK government published a policy since updated, that it would "consider OSS solutions alongside proprietary ones in IT procurements," "only use products for interoperability that support open standards and specifications in all future IT developments," and explore the possibility of using OSS/FS as the default exploitation route for government-funded research and development (R&D) software. Similar policies have been developed in Denmark, Sweden, and The Netherlands.

European policy encouraging the exploration and use of OSS/FS has been consequent on the European Commission's eEurope2005—An Information Society for All initiative and its predecessors, such as the i2010 strategy with their associated action plans. These have encouraged the exchange of experiences and best practice examples so as to promote the use of OSS/FS in the public sector and e-government across the European Commission and member states of the European Union (EU). In addition, the EU has funded R&D on health-related OSS/FS applications as well as encouraged open standards and OSS/FS where appropriate in wider policy initiatives.

In other parts of world, Brazil and Peru are among countries whose governments are actively moving toward OSS/FS solutions, for a variety of reasons, including ensuring long-term access to data through the use of open standards (i.e., not being reliant on proprietary software that may not, in the future, be interoperable) and cost reduction. The South African government has a policy favoring OSS/FS, Japan is considering moving e-government projects to OSS/FS, and pro-OSS/FS initiatives are in operation or being seriously considered in Taiwan, Malaysia, South Korea, and other Asia Pacific countries.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Open Source Licensing

1. Types of OSS/FS licenses
   a. A large and growing number of OSS/FS licenses exist
   b. The OSI Web site currently lists over 60
   c. The two main licenses are the GNU GPL and the Berkeley system distribution (BSD)-style licenses

   d. It is estimated that about 75 percent of OSS/FS products use the GNU GPL
      (1) This license is designed to ensure that user freedoms under the license are protected in perpetuity
      (2) Users are allowed to do almost anything they want to a GPL program
      (3) The conditions of the license primarily affect the user when it is distributed to another user
   e. BSD-style licenses are so named because they are identical in spirit to the original license issued by the University of California, Berkeley
      (1) These are among the most permissive licenses possible
      (2) Essentially permit users to do anything they wish with the software
      (3) Providing the original licensor is acknowledged by including the original copyright notice in source code files and no attempt is made to sue or hold the original licensor liable for damages

Teaching Tip

Here is an example from the GNU GPL that talks about limitations: 16. Limitation of Liability. In no event unless required by applicable law or agreed to in writing will any copyright holder, or any other party who may modify and/ or redistribute the program as permitted above, be liable to you for damages, including any general, special, incidental, or consequential damages arising out of the use or inability to use the program (including but not limited to loss of data or data being rendered inaccurate or losses sustained by you or third parties or a failure of the program to operate with any other programs), even if such holder or other party has been advised of the possibility of such damages.

Teaching Tip

Provide the following example, in relation to using OSS/FS within a healthcare environment, as with use of any software, legal counsel should be consulted to review any license agreement made; however, in general terms, when using OSS/FS there are no obligations that would not apply to using any copyrighted work.

   f. Perhaps the most difficult issue comes when integrating OSS/FS components into a larger infrastructure, especially where it may have to interface with proprietary software
   g. Much has been said about the "viral" nature of the open source license, which comes from the requirement of making source code available if the software is redistributed
   h. Care must be taken that components utilized in creating proprietary software either utilize OSS/FS components in such a way as to facilitate distribution of the code or avoid their use
   i. If the component cannot be made available without all of the source code being made available, then the developer has the choice of not using the component or making the entire application open source
   j. Some projects have created separate licensing schemes to maintain the OSS/FS license and provide those vendors that wish to integrate components without making their product open source

2. Licensing is a complex issue
   a. The best advice is always to read the license agreement and understand it
   b. In the case of a business decision on software purchase or use, one should always consult legal counsel
   c. One should remember that OSS/FS licenses are more about providing freedom than about restricting use

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

OSS/FS Applications

1. Many OSS/FS alternatives exist to more commonly known applications
2. These are likely to include the following:
   a. Operating system
   b. Web browser
   c. E-mail client
   d. Word processing or integrated office suite
   e. Presentation tools
3. Using OSS/FS does not require an all or nothing approach
4. Much OSS/FS can be mixed with proprietary software and a gradual migration to OSS/FS is an option for many organizations or individuals
5. When using a mixture of OSS/FS and proprietary or commercial software, incompatibilities can be uncovered and cause problems whose severity must be assessed
6. Many OSS/FS applications have versions that will run on non-OSS/FS operating systems, so that a change of operating system, for example, to one of the many distributions of Linux, is not necessarily needed
7. Most OSS/FS operating systems now have graphical interfaces that look very similar to Windows or Apple interfaces

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Operating Systems: GNU/Linux

1. A GNU/Linux distribution named in recognition of the GNU Project's significant contribution
2. Often just called Linux and contains the Linux kernel at its heart and all the OSS/FS components required to produce full operating system functionality
3. GNU/Linux is a term that is increasingly used by many people to cover a distribution of operating systems and other associated software components
4. Linux was originally the name of the kernel created by Linus Torvalds, which has grown from a one-man operation to now having over 200 maintainers representing over 300 organizations

5. A kernel is the critical center point of an operating system that controls central processing unit (CPU) usage, memory management, and hardware devices
   a. It also mediates communication between the different programs running within the operating system
   b. The kernel influences performance and the hardware platforms that the OSS/FS system can run on
   c. The Linux kernel has been ported to run on almost any hardware, from mainframes and supercomputers, through desktop, laptop, and tablet machines, to mobile phones and other mobile devices
   d. The Linux kernel is OSS/FS, licensed under the GNU GPL
6. Over time, individuals and companies began distributing Linux with their own choice of OSS/FS packages bound around the Linux kernel
7. The concept of the *distribution* was born, which contains much more than the kernel (usually only about 0.25% in binary file size of the distribution)
8. There is no single Linux distribution
9. Many commercial distributions and freely available variants exist, with numerous customized distributions that are targeted to the unique needs of different users
10. While all distributions contain the Linux kernel
    a. Some contain only OSS/FS materials
    b. Others additionally contain non-OSS/FS components
    c. The mix of OSS/FS
11. The Debian GNU/Linux distribution is one of the few distributions that is committed to including only OSS/FS components (as defined by the open source initiative) in its core distribution
12. Ubuntu, Linux Mint, and PCLinuxOS are generally viewed as the easiest distributions for new users who wish to simply test or gain a general familiarity with Linux
13. Slackware Linux, Gentoo Linux, and FreeBSD are distributions that require a degree of expertise and familiarity with Linux if they are to be used effectively and productively
14. openSUSE, Fedora, Debian GNU/Linux, and Mandriva Linux are mid-range distributions in terms of both complexity and ease of use
15. Google has released their version of an open source operating system called Android
    a. It is suited for a wide range of devices from personal computer to mobile device

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Web Browser and Server: Firefox and Apache

1. An OSS/FS application, the Apache HTTP server, developed for Unix, Windows NT, and other platforms, is currently the top Web server
   a. Apache has dominated the public Internet Web server market ever since it grew to become the number 1 Web server in 1996
   b. Apache began development in early 1995
   c. Is an example of an OSS/FS project that is maintained by a formal structure, the Apache Software Foundation
2. Firefox (technically Mozilla Firefox) is an OSS/FS graphical Web browser, designed for standards compliance, and with a large number of browser features
   a. It derives from the Mozilla Application Suite
   b. Aims to continue Netscape Communicator as an open project
   c. Is maintained by the Mozilla Organization and employees of several other companies, as well as contributors from the community
   d. Firefox source code is OSS/FS, and is tri-licensed, under the Mozilla Public License (MPL), the GNU GPL, and the GNU Lesser General Public License (LGPL)
   e. As of May 2010, Firefox had over 24 percent worldwide usage share of Web browsers
   f. The second most used browser, after Internet Explorer
   g. Some reports show higher market shares, up to 30 percent, in some European countries

Word Processing or Integrated Office Suite: OpenOffice (Office Productivity Suite)

1. While OSS/FS products have been strong on the server side, OSS/FS desktop applications are relatively new and few
2. OpenOffice (strictly OpenOffice.org), which is based on the source code of the formerly proprietary StarOffice, is an OSS/FS equivalent of Microsoft Office, with most of its features
3. It supports the ISO/IEC standard OpenDocument Format (ODF) for data interchange as its default file format, as well as Microsoft Office formats among others
4. As of November 2009, OpenOffice supports over 110 languages
5. It includes
   a. A fully featured word processor
   b. Spreadsheet
   c. Presentation software
6. OpenOffice reads most Microsoft Office documents without problems
7. Will save documents to many formats, including Microsoft Word (but not vice versa)
8. OpenOffice has been used in recent high profile switches from Windows to Linux
9. OpenOffice has versions that will run on Windows, Linux, and other operating systems
10. The OpenOffice suite contains a presentation component, called Impress
    a. Which produces presentations very similar to PowerPoint
    b. Can be saved and run in OpenOffice format on Windows or Linux desktop environments
    c. Or exported as PowerPoint versions

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Some Other OSS/FS Applications

1. BIND
    - **a.** The Berkeley Internet Name Domain (BIND) is a domain name system (DNS) server, or in other words, an Internet naming system
    - **b.** Internet addresses, such as www.google.com or www.openoffice.org, would not function without DNS
    - **c.** These servers take these human-friendly names and convert them into computer-friendly numeric Internet protocol (IP) addresses and vice versa
    - **d.** Without these servers, users would have to memorize numbers such as 74.125.19.104 in order to use a Web site, instead of simply typing www.google.com
    - **e.** The BIND server is an OSS/FS program developed and distributed by the University of California at Berkeley
    - **f.** It is licensed under a BSD-style license by the Internet Software Consortium
    - **g.** It runs 95 percent of all DNS servers, including most of the DNS root servers
    - **h.** These servers hold the master record of all domain names on the Internet
2. Perl
    - **a.** Practical Extraction and Reporting Language (Perl) is a high-level programming language that is frequently used for creating CGI (common gateway interface) programs
    - **b.** Started in 1987, and now developed as an OSS/FS project
    - **c.** It was designed for processing text and derives from the C programming language and many other tools and languages
    - **d.** It was originally developed for Unix and is now available for many platforms
    - **e.** Perl modules and add-ons are available to do almost anything
    - **f.** Leading some to call it the “Swiss Army chainsaw” of programming languages
3. PHP
    - **a.** PHP stands for PHP Hypertext Preprocessor
    - **b.** The name is an example of a recursive acronym (the first word of the acronym is also the acronym), a common practice in the OSS/FS community for naming applications
    - **c.** PHP is a server-side, HTML-embedded scripting language used to quickly create dynamically generated Web pages
    - **d.** In an HTML document, PHP script (similar syntax to that of Perl or C) is enclosed within special PHP tags
    - **e.** PHP can perform any task any CGI program can
    - **f.** Its strength lies in its compatibility with many types of relational databases
    - **g.** PHP runs on every major operating system, including Unix, Linux, Windows, and Mac OS X and can interact with all major Web servers
4. GT.M
    - **a.** Is a database engine with scalability proven in the largest real-time core processing systems in production at financial institutions worldwide
    - **b.** As well as in large, well known healthcare institutions
    - **c.** With a small footprint that scales down to use in small clinics, virtual machines, and software appliances
    - **d.** The GT.M data model is a NOSQL hierarchical associative memory (i.e., multidimensional array) that imposes no restrictions on the data types of the indexes and the content—the application logic can impose any schema, dictionary, or data organization suited to its problem domain
    - **e.** GT.M’s compiler for the standard M (also known as MUMPS) language is the basis for an open source stack for implementation of the VistA Hospital Information System
5. LAMP
    - **a.** The Linux, Apache, MySQL, PHP/Perl/Python (LAMP) architecture has become very popular as a way of affordably deploying reliable, scalable, and secure Web applications
    - **b.** The “P” in LAMP can also stand for either PHP or Perl or Python
    - **c.** MySQL is a multithreaded, multiuser, SQL (Structured Query Language) relational database server, using the GNU GPL
    - **d.** The PHP-MySQL combination is also a cross-platform (i.e., it will run on Windows as well as Linux servers) (Murray & Oyri, 2005)
6. Content management systems
    - **a.** Many OSS/FS applications, especially modern content management systems (CMS) that are the basis of many of today’s interactive Web sites, use LAMP
    - **b.** Has a flexible, modular framework that separates the content of a Web site (the text, images, and other content) from the framework of linking the pages together and controlling how the pages appear
    - **c.** In most cases, this is done to make a site easier to maintain than would be the case if it was built exclusively out of flat HTML pages
    - **d.** There are now over 200 OSS/FS FLOSS content management systems (see php.opensourcecms.com for an extensive list) designed for developing portals and Web sites with dynamic, fully searchable content
    - **e.** Can be easily administrated and moderated at several levels by members of an online community, which gives complete control of compliance with the organization’s policy for published material and provides for greater interactivity and sense of ownership by online community members
    - **f.** The workload relating to publication of material and overall maintenance of the Web site can be spread among many members, rather than relying on one Web spinner

Teaching Tip

Provide the following examples Drupal (drupal.org), for example, is one of the most well-known and widely used CMS and is currently used for the official site of the White House (www.whitehouse.gov), the United Nations World Food Programme (www.wfp.org), and the South African Government for their official 2010 FIFA World Cup Web site (www.sa2010.gov.za). MyOpenSourcematrix, a CMS designed for large organizations, has been used by the UK’s Royal College of Nursing to provide a content and communications portal for its 400,000 members.

- **g.** This secures frequent updates of content and reduces individual workloads, making the likelihood of member participation greater
- **h.** The initial user registration and redistribution of passwords and access can be carried out automatically by user requests, while assignment to user groups is made manually by the site administrators or moderator
- **i.** FLOSS applications are gaining widespread use within education sectors, with one example of a widely used e-learning application being Moodle

Teaching Tip
Provide the following example Moodle is a complete e-learning course management system, or virtual learning environment (VLE), with a modular structure designed to help educators create high-quality, multimedia-based online courses. Moodle is translated into more than 30 languages, and handles thematic or topic-based classes and courses. As Moodle is based in social constructivist pedagogy, it also allows the construction of e-learning materials that are based around discussion and interaction, rather than static content.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

OSS/FS Healthcare Applications

1. Overview
- **a.** It is suggested that in healthcare, as in many other areas, the development of OSS/FS may provide much-needed competition to the relatively closed market of commercial, proprietary software and thus encourage innovation
  - **(1)** This could lead to lower cost and higher quality systems that are more responsive to changing clinical needs
  - **(2)** OSS/FS could also solve many of the problems health information systems currently face including lack of interoperability and vendor lock-in, cost, difficulty of record and system maintenance given the rate of change and size of the information needs of the health domain, and lack of support for security, privacy, and consent
  - **(3)** This is because OSS/FS more closely conforms to standards and its source code open to inspection and adaptation
  - **(4)** A significant motive for supporting the use of OSS/FS and open standards in healthcare is that interoperability of health information systems requires the consistent implementation of open standard
  - **(5)** Open standards, as described by the International Telecommunications Union (ITU), are made available to the general public and developed, approved, and maintained via a collaborative and consensus-driven process
- **b.** A key element of the process is that, by being open, there is less risk of being dominated by any single interest group
  - **(1)** Bowen et al. summarize a number of advantages that open source software offers when compared with proprietary software, including, but not limited to, the following
    - **i.** Ease of modification and or customization
    - **ii.** The large developer community and its benefits
    - **iii.** Increased compliance with open standards
    - **iv.** Enhanced security
    - **v.** Increased likelihood of source code availability in the event of the demise of the vendor or company
    - **vi.** Easier to adapt for use by healthcare students
    - **vii.** And the flexibility of source code to adapt to research efforts
  - **(2)** The cost effectiveness of open source software also lends well to communities or organizations requiring such an approach
    - **i.** For example, long-term care facilities
    - **ii.** Assisted living communities
    - **iii.** Clinics (public health and educational venue clinics)
    - **iv.** And home care
- **c.** Yellowlees, Marks, Hogarth, and Turner are among those who suggest that many of the current EHR systems tend to be expensive, inflexible, difficult to maintain, and rarely interoperable across health systems; this is often due to their being proprietary systems
  - **(1)** This makes clinicians reluctant to use them, as they are seen as no better than paper-based systems
  - **(2)** OSS/FS has been very successful in other information-intensive industries, and so is seen as having potential to integrate functional EHR systems into, and across, wider health systems
  - **(3)** They believe that interoperable open source EHR systems would have the potential to improve healthcare in the United States, and cite examples from other areas around the world
- **d.** Currently, there is much interest in interoperability testing of systems, not only between proprietary systems, but also among OSS/FS systems, and between OSS/FS systems and proprietary systems
  - **(1)** Integrating the Healthcare Enterprise (IHE) has developed a range of open source interoperability testing tools, called MESA, KUDU, and its next generation tool GAZELLE, to test healthcare interoperability according to the standards profiled by the IHE in its technical frameworks
  - **(2)** The Certification Commission for Health Information Technology (CCHIT) has developed an open source program called Laika to test EHR software for compliance with CCHIT interoperability standards
- **e.** There are, of course, potential limitations regarding open source EHRs
  - **(1)** Technology staff may require education in order to be adept with understanding and supporting open source solutions

  - **(2)** Open source efforts are more likely to be underfunded, which impacts not only the ability to upgrade but also support of the software
  - **(3)** Another limitation is the perception of open source solutions as the forgotten stepchild of certification (at least in the United States)
  - **(4)** Only recently (mid-2009) did the CCHIT modify requirements to allow for more than just proprietary EHRs to become certified
  - **(5)** Additional barriers include limited interoperability, fuzzy ROI, slower uptake by users than proprietary software, personnel resistance to this change, and, as previously alluded, IT employees unfamiliar with open source software
  - **(6)** Other barriers to use of OSS/FS for implementation of EHRs or health information systems (HIS) have been identified, including resistance to change among users and IT departments, lack of documentation associated with some OSS/FS projects, and language barriers in some countries, in particular due to the documentation around many OSS/FS developments being in English, without translation

Teaching Tip

It is suggested for the students work in teams and discuss the case study. The students should report their findings back to the class.

In the case study, we will look at one project, probably the largest, most sophisticated, and furthest developed—VistA. Here we will provide a brief overview of examples of some of the other projects currently existing, some of which have been in development for over 15 years. Many share commonalities in trying to develop components of EHRs and several have online demonstration versions available for exploration. A useful summary of the known projects and products has been provided by the AMIA OSWG, while a number of Web sites provide catalogues of known OSS/FS developments in health.

Examples exist of OSS/FS electronic medical records (EMRs), hospital management systems, laboratory information systems, radiology information systems, telemedicine systems, picture archiving and communications systems, and practice management systems. A few examples indicate this range, and more extensive lists and descriptions are available at several Web portals.

2. ClearHealth
- **a.** Is a Web-based, fully comprehensive medical suite
- **b.** Offers a wide range of tools to practices of all sizes
- **c.** Includes
  - **(1)** Scheduling and registration features
  - **(2)** Alerts
  - **(3)** Patient dashboard
  - **(4)** Laboratory ordering and results
  - **(5)** Barcode generation
- **d.** Uses SNOMED
- **f.** Access via mobile devices
- **g.** Billing and reporting features
- **h.** Specialist clinical modules

1. Indivo
- **a.** Is the original personal health platform
- **b.** Enable an individual to own and manage a complete, secure, digital copy of their health and wellness information
- **c.** Integrates health information across sites of care and over time
- **d.** Is free
- **e.** Open-source
- **f.** Uses open, unencumbered standards and
- **g.** Includes those of the SMART Platform project
- **h.** Is actively deployed in diverse settings
- **i.** Integrates health information across sites of care and over time
- **j.** Is actively deployed in diverse settings

Teaching Tip

For example, in the Children's Hospital Boston and the Dossia Consortium.

2. SMART platforms project
- **a.** The project is
  - **(1)** An open-source
  - **(2)** Developer-friendly application programming interface
  - **(3)** Is an extensible medical data representation
  - **(4)** Standards-based clinical vocabularies
- **b.** Allows healthcare clients to make their own customizations
- **c.** These apps can then be licensed to run across the installed base
- **d.** As of 2014, SMART works with
  - **(1)** Cerner Millennium at Boston Children's Hospital, running the SMART app BP Centiles
  - **(2)** i2b2, (a clinical discovery system used at over 75 US academic hospitals)
  - **(3)** Indivo, (an advanced personally controlled health record system)
  - **(4)** Mirth Results, (a clinical data repository system for HIEs)
  - **(5)** OpenMRS, (a common framework for medical informatics efforts in developing countries)
  - **(6)** Think!Med Clinical, (an openEHR-based clinical information system)
  - **(7)** WorldVistA, an open source EMR based on the US Department of Veterans Affairs VistA system

3. GNUMed
- **a.** Builds free, liberated open source Electronic Medical Record software in multiple languages to assist and improve longitudinal care (specifically in ambulatory settings, i.e., multiprofessional practices and clinics)
- **b.** It is made available at no charge
- **c.** Is capable of running on
  - **(1)** GNU/Linux
  - **(2)** Windows
  - **(3)** Mac OS X

   - **d.** It is developed by a handful of medical doctors and programmers from all over the world

6. OpenMRS

   - **a.** OpenMRS® is a community-developed, open source enterprise EMR system platform
   - **b.** Of particular interest to this project is supporting efforts to actively build and/or manage health systems in the developing world to address
     - **(1)** AIDS
     - **(2)** Tuberculosis
     - **(3)** Malaria
   - **c.** Their mission is to foster self-sustaining health IT implementations in these environments through peer mentorship
   - **d.** Proactive collaboration, and a code base equaling or surpassing any proprietary equivalent
   - **e.** Is a multi-institution, nonprofit collaborative led by
     - **(1)** Regenstrief Institute, Inc.
     - **(2)** Partners In Health
   - **f.** Has been implemented in 20 countries throughout the world
   - **g.** This effort is supported in part by organizations such as
     - **(1)** The World Health Organization (WHO)
     - **(2)** The Centers for Disease Control (CDC)
     - **(3)** The Rockefeller Foundation,
     - **(4)** The President's Emergency Plan for AIDS Relief (PEPFAR)

7. District Health Information System

   - **a.** The District Health Information System (DHIS) provides for data entry, report generation, and analysis.
   - **b.** It is part of a larger initiative for healthcare data in developing countries, called the Health Information System Program (HISP)

8. OpenEHR

   - **a.** The Foundation is an international, not-for-profit organization working toward the development of interoperable, lifelong EHRs
   - **b.** It is also looking to reconceptualize the problems of health records through an understanding of the
     - **(1)** Social
     - **(2)** Clinical
     - **(3)** Technical challenges of electronic records
   - **c.** The Foundation was created to enable the development of
     - **(1)** Open specifications
     - **(2)** Software
     - **(3)** Knowledge resources for health information systems
   - **d.** It publishes all its specifications
   - **e.** Builds reference implementations as OSS/FS
   - **f.** It also develops archetypes and a terminology for use with EHRs

9. Tolven

   - **a.** Is developing a range of electronic personal and clinician health record applications
   - **b.** Uses open source software
   - **c.** Uses health industry standards including
     - **(1)** Unified Medical Language Systems
     - **(2)** Health Level 7

Teaching Tip

Provide the following background information, the EU has funded research and development programmes through the European Commission. There have been many projects and initiatives to explore and promote the use of OSS/FS within EU member states and organizations. While many of the earlier initiatives were projects whose outputs were not further developed, or are no longer available, several of them laid the basis for current initiatives, such as the Open Source Observatory and Repository Portal. Among the early EU projects are the following:

1. SMARTIE

   - **a.** Sought to offer a comprehensive collection, or suite
     - **(1)** Selected medical software decision tools
     - **(2)** Ranging from clinical calculators (i.e., risk factor scoring) up to advanced medical decision support tools (i.e., acute abdominal pain diagnosis)

2. openECG

   - **a.** Sought to consolidate interoperability efforts in computerized electrocardiography at the European and international levels
   - **b.** Encourages the use of standards
   - **c.** The project aimed to promote the consistent use of format and communications standards for computerized ECGs
   - **d.** Pave the way toward developing similar standards for
     - **(1)** Stress ECG
     - **(2)** Holter ECG
     - **(3)** Real-time monitoring
   - **e.** The openECG portal still provides information on interoperability in digital electrocardiography
   - **f.** One of the project's outputs, the Standard Communications Protocol for Computer-Assisted Electrocardiography (SCP-ECG) was approved as an ISO standard, ISO/DIS 11073-91064

3. Open source medical image analysis (OSMIA)

   - **a.** Was designed to provide an OSS/FS development environment for medical image analysis research in order to facilitate the free and open exchange of ideas and techniques

4. PICNIC

   - **a.** From Minoru Development
   - **b.** Was designed to help regional health care providers to develop and implement the next generation of
     - **(1)** Secure
     - **(2)** User-friendly regional healthcare networks
     - **(3)** To support new ways of providing health and social care

5. Free/Libre/Open Source Software: Policy Support (FLOSSpols)
    - **a.** Aim to work on three specific tracks
        - **(1)** Government policy toward OSS/FS
        - **(2)** Gender issues in open source
        - **(3)** The efficiency of open source as a system for collaborative problem solving
    - **b.** It should be noted that many of these are R&D projects only
    - **c.** Not guaranteed to have any lasting effect or uptake beyond the lifespan of the project
6. The Open Source Observatory and Repository for European public administrations is a major portal that
    - **a.** Supports and encourages the collaborative development and reuse of publicly financed free, libre, and open source software (FLOSS) applications developments for use in European public administrations
    - **b.** It is a platform for
        - **(1)** Exchanging information
        - **(2)** Experiences
        - **(3)** FLOSS-based code
    - **c.** It also promotes and links to the work of national repositories
    - **d.** Encourages the emergence of a pan-European federation of open source software repositories
    - **e.** Is financed by the European Commission through the initiative Interoperable Delivery of European eGovernment Services to Public Administrations, Businesses and Citizens (IDABC)
    - **f.** Is supported by European governments at national, regional, and local levels
    - **g.** Indexes and describes a number of health-related initiatives
        - **(1)** Some directly related to providing health care
        - **(2)** Others with lessons that might be applicable across a number of sectors, including healthcare
    - **h.** Organizations and resources

Teaching Tip

Provide the following as health-specific initiatives:

Health Atlas Ireland: An OSS/FS application using geographical information systems (GIS), health-related datasets, and statistical software. It received the Irish Prime Minister Public Service Excellence Award because of its capacity to innovate and to improve the quality and the efficiency health services. Health Atlas Ireland is an open source application developed to use a Web environment to add value to existing health data; it also enables controlled access to maps, data, and analyses for service planning and delivery, major incident response, epidemiology, and research to improve the health of patients and the population.

Many hospitals and healthcare institutions in the EU are increasing their use of open source software.

The University Hospital of Clermont Ferrand began using OSS/FS to consolidate data from multiple computer systems in order to improve its invoicing.

The Centre Hospitalier Universitaire Tivoli in Louvière, Belgium in 2006 estimated that about 25 percent of its software was OSS/FS, including enterprise resource planning (ERP) software, e-mail applications, VPN software openVPN, and the K-Pacs OSS/FS DICOM viewing software.

Additionally, many hospitals are moving their Web sites and portals to OSS/FS content management systems, such as Drupal.

The St. Antonius hospital in the cities of Utrecht and Nieuwegein (The Netherlands) are migrating to an almost completely OSS/FS IT environment, with 3000 desktops running Ubuntu GNU/Linux, and using OpenOffice for office productivity tools.

Growing numbers of examples of the use of OSS/FS for developing hospital and HISs exist, especially in developing countries.

1. Over the past 10 years a number of organizations have sought to explore and, where appropriate, advocate the use of OSS/FS within health, healthcare, and nursing
2. Some of these are still active
3. Others have struggled to maintain activity due to having to rely primarily on voluntary efforts
4. Current efforts in promoting and publicizing OSS/FS seem to be based around
    - **a.** Looser collaborations
    - **b.** Less formal groups
    - **c.** Often working on developing and maintaining information resources
5. The American Medical Informatics Association (AMIA), International Medical Informatics Association (IMIA), and the European Federation for Medical Informatics (EFMI) all have working groups dealing with OSS/FS who
    - **a.** Develop position papers
    - **b.** Contribute workshops
    - **c.** Organize conferences
    - **d.** Undertake a variety of other promotional activities
6. Each of these groups have nurses actively involved
7. National (in all countries) and international health informatics organizations seem to be late in realizing the need to consider the potential impact of OSS/FS
8. The IMIA established an Open Source Health Informatics Working Group in 2002
    - **a.** It aims to work both within IMIA
    - **b.** And through encouraging joint work with other OSS/FS organizations to explore issues around the use of OSS/FS within healthcare and health informatics

9. The mission of the AMIA OSWG
   - **a.** Is to act as the primary conduit between AMIA and the wider open source community
   - **b.** Its specific activities include
     - **(1)** Providing information regarding the benefits and pitfalls of OSS/FS to other AMIA working groups
     - **(2)** Identifying useful open source projects
     - **(3)** Identifying funding sources and providing grant application support to open source projects
   - **c.** The AMIA OSWG produced a White Paper in late 2008 that
     - **(1)** Not only addressed and summarized many of the issues on definitions and licensing
     - **(2)** Provided a list of the major OSS/FS electronic health and medical record systems in use, primarily in the United States, at the time
     - **(3)** The AMIA OSWG identified 12 systems, in use in over 2500 federal government and almost 900 nonfederal government sites, which among them held over 32 million individual patient records
10. The IMIA-OSWG, in collaboration with several other organizations, including the AMIA-OSWG, organized a series of think-tank meetings in 2004, in Winchester, UK, and San Francisco, United States
    - **a.** The main purpose of these events was to "identify key issues, opportunities, obstacles, areas of work and research that may be needed, and other relevant aspects, around the potential for using open source software, solutions and approaches within healthcare, and in particular within health informatics, in the United Kingdom and Europe"
    - **b.** Three-quarters of attendees at the first event (United Kingdom, February 2004) described their ideal vision for the future use of software in healthcare as containing at least a significant percentage of OSS/FS
    - **c.** Nearly one-third of the attendees wanting to see an "entirely open source" use of software in healthcare
    - **d.** Similar findings arose from the US meeting of September 2004, which had broader international participation
    - **e.** The emergence of a situation wherein OSS/FS would interface with proprietary software within the healthcare domain was seen to be achievable and desirable
    - **f.** Such use was also likely if the right drivers were put in place and barriers addressed
    - **g.** Participants felt the strongest drivers included the following
      - **(1)** Adoption and use of the right standards
      - **(2)** The development of a FLOSS "killer application"
      - **(3)** A political mandate toward the use of FLOSS
      - **(4)** Producing positive case studies comparing financial benefits of FLOSS budget reductions
    - **h.** Participants rated the most important issues why people might use or do use FLOSS within the health domain as
      - **(1)** Quality
      - **(2)** Stability
      - **(3)** Robustness of software and data
      - **(4)** Long-term availability of important health data because of not being "locked up" in proprietary systems that limit interoperability and data migration
    - **i.** They felt the two most important areas for FLOSS activity by IMIA OSWG and other FLOSS groups were
      - **(1)** Political activity
      - **(2)** Efforts toward raising awareness among healthcare workers and the wider public
    - **j.** There was a feeling, especially from the US meeting, that lack of interaction between OSS/FS groups was a barrier to adoption in healthcare
11. Discussions at meetings in 2008 and 2009, and in particular at the Special Topic Conference of the European Federation for Medical Informatics (EFMI) held in London in September 2008, and at the Medical Informatics Europe (MIE) 2009 conference held in Sarajevo, Bosnia and Herzegovina, reflected back on progress made since 2004
    - **a.** It was concluded that many of the issues identified in 2004 remained relevant
    - **b.** Some progress had been made in raising awareness within health and nursing communities of the possibilities of OSS/FS
    - **c.** The same issues were still relevant
12. To date, few nursing or NI organizations have sought to address the implications of OSS/FS from a nursing-focused perspective.
    - **a.** The first nursing or NI organization to establish a group dealing with OSS/FS issues was the Special Interest Group in Nursing Informatics of IMIA (IMIA/NI-SIG)
    - **b.** Established in June 2003, the IMIA-NI Open Source Nursing Informatics (OSNI) Working Group has many aims congruent with those of the IMIA OSWG, but with a focus on
      - **(1)** Identifying and addressing nursing-specific issues
      - **(2)** Providing a nursing contribution within multiprofessional or multidisciplinary domains
    - **c.** It has been difficult to maintain specific nursing-focused activity and many members now work within other groups, to provide nursing input
13. Among providers of resources, the Medical Free/Libre and Open Source Software Web site
    - **a.** Provides a comprehensive and structured overview of OSS/FS projects in the healthcare domain

   - **b.** It also offers an open content platform to foster the exchange of ideas, knowledge, and experiences about projects

14. The International Open Source Network (IOSN)

   - **a.** Funded by the United Nations Development Program (UNDP)
   - **b.** Is a center of excellence for OSS/FS in the Asia-Pacific region
   - **c.** It is tasked specifically with facilitating and networking OSS/FS advocates in the region
   - **d.** Developing countries in the region can achieve rapid and sustained economic and social development by using affordable, yet effective, OSS/FS solutions to bridge the digital divide
   - **e.** While its work and case studies have a focus on developing countries, and especially those of the Asia-Pacific region, the materials they produce are of wider value
   - **f.** In particular are the FOSS primers, which serve as introductory documents to OSS/FS in general as well as covering particular topic areas in greater detail
   - **g.** Their purpose is to raise FLOSS awareness, particularly among policy makers, practitioners, and educators
   - **h.** While there is not currently a health offering, the general lessons from the primers on education, open standards, OSS/FS licensing and the general introductory primer to OSS/FS are useful materials for anyone wishing to explore the issues in greater detail

15. Open Health Tools

   - **a.** Is an open source community
   - **b.** With members including national health agencies from several countries, medical standards organizations, and software product and service companies
   - **c.** Its vision is of enabling a ubiquitous ecosystem where members of the health and informatics professions can collaborate to build interoperable systems

SUMMARY

- OSS/FS has been described as a disruptive paradigm, but one that has the potential to improve not only the delivery of care, but also healthcare outcomes
- This chapter provides a necessarily brief introduction to OSS/FS
- While we have tried to explain the underlying philosophies of the two major camps, only an in-depth reading of the explanations emanating from each can help to clarify the differences
- Many of the issues we have addressed are in a state of flux, therefore we cannot give definitive answers or solutions to many of them, as debate and understanding will have moved on
- As we have already indicated, detailed exploration of licensing issues is best addressed with the aid of legal counsel
- Readers wishing to develop a further understanding of OSS/FS are recommended to read the International Open Source Network's (IOSN) Free and Open Source Software (FOSS) Primer

Discussion Tip

Ask the students to summarize what were the most important things they learned from the chapter.

Teaching Tip

Review the chapter objectives.

1. Describe the basic concepts of open source software (OSS) and free software (FS).
2. Describe the differences between open source software, free software, and proprietary software, particularly in respect of licensing.
3. Discuss why an understanding of open source and free software is important in a healthcare context, in particular where a choice between proprietary and open source software or free software is being considered.
4. Describe some of the open source and free software applications currently available, both healthcare-specific and for general office/productivity use.
5. Introduce some of the organizations and resources available to assist the nurse interested in exploring the potential of open source software.
6. Create and develop an example of OSS.
7. Describe the organization of health databases.
8. Use Boolean Logic to form query conditions.
9. Understand methods for querying and reporting from databases (VistA FileMan, SQL).

Teaching Tip

Ask the students to define the keywords.

- Querying databases
- Boolean Logic
- Open source software
- Free software
- Linux

CHAPTER REVIEW QUESTIONS

Question 5.1: What are the differences between Open Source Software and Free Software (OSS/FS)? Answer whether True or False.

a. FSF is defined by four freedoms: To use, study, redistribute, and improve.	True ___	False ___
b. OSS/FS both make their source code available to users.	True ___	False ___
c. FSF is ethical and philosophical whereas OSS is more practical and proprietary.	True ___	False ___

d. OSS does not allow it to be modified and/or redistributed. True ___ False ___

e. There is no difference between FSF and OSS. True ___ False ___

Question 5.2: What was the most significant OSS/FS developmental process?

a. Developed in secret and disseminated for a licensing fee

b. Revolutionized way in which programming languages are developed

c. Developed by voluntary efforts of highly skilled programmers

d. Coordinated through isolated experts

Question 5.3: Which represent/s the proposed benefits of OSS/FS?

a. OSS/FS is available as royalty free and at a low or no cost

b. OSS/FS requires permission and is available at a high cost

c. OSS/FS lacks security and stability

d. OSS/FS lacks resources

Question 5.4: What are some of the major issues in the use of OSS/FS?

a. Copyright/Intellectual Property, Innovation, and Security/Stability

b. Copyright/Intellectual Property, Licensing, and Security/Stability

c. Business Models, Security/Stability, and Innovation

d. Licensing, Resources, and Business Models

Question 5.5: What represents one of the Three-Step Method for OSS/FS Decision Making?

a. Define License/Copyright problems

b. Reviews business model and resources

c. Undertake a detailed review of hardware selection

d. Identify the options for software selection

Question 5.6: What is a major advantage of OSS/FS software licensing?

a. Restricts a person's right to use OSS/FS software

b. Does not allow the users to legally sell the software

c. It is seen in terms of permission or rights of the users

d. It is a model that restricts the rights and redistribution conditions

Question 5.7: What are the challenges traditionally seen in migrating to OSS/FS software?

a. Lack of Desktop Applications, Not User-Friendly, and File Sharing Difficult

b. Not User-Friendly, Copyright Issues, and File Sharing Difficult

c. File Sharing Difficult, Lack of Desktop Applications and Copyright Issues

d. Lack of Desktop Applications, Not User-Friendly and Licensing Costs

Question 5.8: What common applications most nurses use on a daily basis?

a. Web Browser, E-mail, PowerPoint, and Operating System

b. Web Browser, E-mail, Word Processing, and Operating System

c. PowerPoint, Word Processing, E-mail, and Operating System

d. E-mail, Operating System, PowerPoint, and Web Browser

Question 5.9: What is an acceptable OSS/FS application?

a. List of fees for Access to LANs, WANs, or Internet

b. Model of the structure of the Hardware Architecture

c. Operating system such as one for GNU/Linux

d. List of software charges and User fee Licensing

Question 5.10: What conditions are needed for OSS/FS to interface with proprietary software within the healthcare domain?

a. Adoption and use of the right standards, Development of a FLOSS "Killer Application," Political Mandate to use FLOSS, and Proof of Financial benefits of FLOSS

b. Proof of Financial Benefits of FLOSS, OSS Watch, Adoption and Use of the Right Standards, and Development of a FLOSS "Killer Application"

c. Development of a FLOSS "Killer Application," Adoption and Use of the Right Standards, Proof of Financial benefits of FLOSS, and OSS Watch

d. Adoption and Use of the Right Standards, OSS Watch, Proof of Financial Benefits of FLOSS, and Development of a FLOSS "Killer Application"

ANSWERS AND EXPLANATIONS

Question 5.1:

a. True

b. True

c. True

d. False

e. False

The chapter presents the differences between OSS/FS even though they work together. FS is offered free of charge—asserts that open source is a development methodology that does not have any restrictions whereas OSS has a copyright restricting other people's access to the software source code.

Question 5. 2: (c) Developed by voluntary efforts of highly skilled programmers. This description emphasized that the OSS/FS was developed by highly skilled volunteer programmers. Many OSS/FS applications are coordinated through formal groups.

Question 5.3: (a) OSS/FS is available as royalty free and at a low or no cost. OSS/FS source code is accessible to the user. Any person can see how the Software works and can make changes to the functionality. Other benefits include lack of proprietary lock-in that can freeze out innovations.

Question 5.4: (b) Copyright and Intellectual Property, Licensing, and Security/Stability. No true OSS/FS application charges a licensing fee for usage, thus on a licensing cost basic OSS/FS applications are almost cheaper than that proprietary software.

Question 5.5: (c) Undertake a detailed review of hardware selection. Choosing the right software can be a difficult process. Using the Three-Step Method can guide organizations through the process. Step 1: Define the needs and constraints; Step 2: Identify the options; and Step 3: Undertake a detailed review. Then make a decision once the review is complete.

Question 5.6: (c) It is seen in terms of permission or rights of the users. Software licensing is giving the user permission to use it whereas in OSS/FS licensing it generally has specific restrictions related to its use, modification, or duplication of the software.

The OSS/FS licenses are designed to facilitate the sharing of software and to prevent an individual or organization from controlling ownership of the software.

Question 5.7: (b) Not User-Friendly, Copyright Issues, and File Sharing Difficult. It is a difficult issue when integrating OSS/FS components into a larger Infrastructure that has proprietary software. The problem comes from the requirement of making source code available if the software is redistributed. Care must be taken that the components utilized in creating proprietary software either utilize OSS/FS components in such a way as to facilitate distribution of the code or avoid its use.

Question 5.8: (c) PowerPoint, Word Processing, E-mail, and Operating System. For each of the above OSS/FS applications exist. Using OSS/FS does not require an all or nothing approach and much OSS/FS cane be mixed with proprietary software a gradual migration to OSS/FS in an option for many organizations or individuals.

Question 5.9: (a) Operating system such as one for GNU/Linux. The GNU/Linus contains Linus kernel at its heart and all the OSS/FS components required to produce full operating system functionality.

Question 5.10: (a) Adoption and use of the right standards, Development of a FLOSS "Killer Application," Political Mandate to use FLOSS, and Proof of Financial benefits of FLOSS. The adoption of right standards included the use of FLOSS within the health domain as quality, stability, and robustness of software and data as well as a long-term availability of health data because of not being "locked up" in proprietary system that limits interoperability and data Migration.

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6

Data and Data Processing

• OBJECTIVES

1. Describe the data-related implications for data and database systems within the data to wisdom continuum.
2. Explain file structures and database models.
3. Describe the purpose, structures, and functions of database management systems (DBMSs).
4. Outline the life cycle of a database system.
5. Explore concepts and issues related to data warehouses, big data, and dashboards.
6. Explain knowledge discovery in databases (KDD) including data mining, data analytics, and benchmarking.

• KEY WORDS

Big data
Dashboard
Data
Database
Data analytics
Data mining
Data warehouse
Information
Knowledge
Knowledge discovery in databases (KDD)
Wisdom

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What databases do you frequently use? What type of queries do you use when using the database? Have you designed a database? Explain the process of designing the database? Is information a synonym for data? How is information different from data? Have you used a database in a clinical setting? What type of information was available in the database?

For a WIIFM statement, say to the class, "This chapter introduces the nurse to basic concepts, theories, models, and issues necessary to understand the effective use of automated database systems and to engage in dialog regarding data analytics, benchmarks, and outcomes."

As a nurse, it is important to understand the importance of how to design a database as well as the structure and function of databases.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

The Nelson Data to Wisdom Continuum

1. The Nelson data to wisdom continuum moves from data to information to knowledge to wisdom with constant interaction within and across these concepts as well as the environment
2. *Data* are raw, uninterrupted facts without meaning
3. *Information* is facts with meaning
4. *Knowledge* is understanding the information
5. *Wisdom* is knowledge used to make appropriate decisions and acting on those decisions
6. Context and pattern knowledge allow the person to understand the meaning and importance of the data and to make decisions
7. Data alone is meaningless
8. Information and knowledge are meaningful
9. Common approaches to organizing data include
    - **a.** Sorting
    - **b.** Classifying
    - **c.** Summarizing
    - **d.** Calculating

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Defining Data and Databases

1. Data states
    - **a.** Three states of digital data
        - **(1)** Data at rest—data on a storage device
        - **(2)** Data in use—data that a database program is reading or writing
        - **(3)** Data in motion—moving between applications, over the network, or over the Internet
2. Databases
    - **a.** An organized collection of related data
    - **b.** The possibility of finding databases depends on the four important factors
        - **(1)** The data naming (indexing) and organizational schemes
        - **(2)** The size and complexity of the database
        - **(3)** The type of data within the database
        - **(4)** The database search methodology
    - **c.** The systematic approach used to name, organize, and store data in a database has a major impact on how easy it is to find information in the database
    - **d.** A large database can be more difficult to search than a small database
    - **e.** The size of a database is a function of not only the amount of data in the database, but also the number and complexity of the relationships between the data
3. Types of data
    - **a.** When developing automated database systems, the designer defines each data element
    - **b.** As part of this process, the designer classifies the data
    - **c.** There are two primary approaches to classifying data in a database system
    - **d.** Data are classified in terms of how the users will use these data
        - **(1)** This is the conceptual view of the data
        - **(2)** Conceptual data classifications may include financial data, patient data, or human resource data
        - **(3)** The conceptual view of the data has a major impact on how the designer indexes the data
    - **e.** Data are classified by their computerized data type
        - **(1)** Data can be numbers or letters, or a combination of both
        - **(2)** The designer uses this classification to build the physical database within the computer system
        - **(3)** It identifies the number of spaces necessary to capture each data element and the specific functions that the system can perform on these data
        - **(4)** Alphanumeric data include letters and numbers in any combination
        - **(5)** Numeric data can be used to perform numeric functions including addition, subtraction, multiplication, and division
        - **(6)** Date and time are special types of numeric data
        - **(7)** Logic data are limited for example Yes or No, True or False, 1 or 2, and On or Off
    - **f.** One of the major advantages of an automated information system is that data elements are captured once and different users can use them many times for different purposes
    - **g.** Basic data can be aggregated and summarized to produce new data and information that a different set of users may use
    - **h.** This is referred to as "data collected once, used many times"
4. Database management system (DBMS)
    - **a.** DBMSs are computer programs that are used to
        - **(1)** Input
        - **(2)** Store
        - **(3)** Modify
        - **(4)** Process
        - **(5)** Access data in a database
    - **b.** Before you can use a DBMS, you must first create the structure for the database using the data elements necessary to manage the data specific to the project
    - **c.** This process of configuring the database software is called database system design
    - **d.** Once you configure the database for the project, you use the database software to enter the project data into the computer
    - **e.** A functioning DBMS consists of three interacting parts
        - **(1)** The data
        - **(2)** The designed database
        - **(3)** The query language that you use to access the data

- **f.** Advantages of an automated DBMS include
  - **(1)** Decreased data redundancy
  - **(2)** Increased data consistency
  - **(3)** Improved access to all data
- **g.** The database management software program uses a structured approach to organize and store data
- **h.** The same software uses a query language, making it possible for the computer to do the work of searching for the data

5. Structure—Fields, records, and files
- **a.** Fields describe the type of data expected in the related field
- **b.** Each row represents a record of the data in each of the fields of the database
- **c.** Each record is assigned a primary identifier (also known as primary key or unique identifier)
- **d.** It is imperative that there is a master patient index with a unique identifier for each patient
- **e.** This is a critical piece for the safe and effective exchange of electronic health information
- **f.** The Office of the National Coordinator for Health IT (ONC) initiated a collaborative patient matching initiative and 3 months later some preliminary findings to include standardized patient identifying attributes
- **g.** All the records together in a table constitute a file
- **h.** A file is defined as a set of related records that have the same data fields
- **i.** A database consists of several files
- **j.** The DBMS can then search across the tables or files to find data related to any one entity in the database as long as they share a common identifier

6. Function—Store, update, retrieve, report
- **a.** The functions of a DBMS are to
  - **(1)** Store the data
  - **(2)** Update the records
  - **(3)** Provide easy retrieval of the data
  - **(4)** Permit report generation
- **b.** Most DBMS permit you to create custom reports based on selections of retrieved data

7. Model
- **a.** A database model is the basis that determines how one
  - **(1)** Stores
  - **(2)** Organizes
  - **(3)** Accesses
  - **(4)** Manipulates the data
- **b.** The American Standards Institute (ANSI) and the Standards Planning and Requirements Committee (SPARC) identified these views or models in 1975
- **c.** There are three main phases of database design
  - **(1)** Conceptual design
  - **(2)** Logical design
  - **(3)** Physical design
- **d.** In 1987, John Zachman described database models through the framework of information architecture
- **e.** Hay identified six views
  - **(1)** Ballpark
  - **(2)** Owner's
  - **(3)** Designer's
  - **(4)** Builder's
  - **(5)** Out-of-context
  - **(6)** Actual system
- **f.** These views are helpful in understanding how different groups will interact with the design and use of a database
- **g.** It is important to remember that creating a database that meets the needs of the organization and end users is a complex process
- **h.** The models and the process of developing them are critical to the success of the database endeavor
- **i.** The following describes three primary views or models
  - **(1)** Conceptual Model—Identifies the entities and the relationship between the entities
  - **(2)** Logical Model—Defines the structure of the whole database in terms of the attributes of the entities, their relationships, as well as a primary key for each entity
  - **(3)** Physical Model – Includes each of the data elements and the relationship between the data elements, as they will be physically stored on the computer
- **j.** Hierarchical database
  - **(1)** Compared to inverted trees, with access to data starting at the top of the hierarchy or at the root
  - **(2)** The table at the root has pointers that point to tables with data that relate hierarchically to the root
  - **(3)** Each table is a node
  - **(4)** A parent node may have several child nodes
  - **(5)** Each child node can only have one parent node
  - **(6)** Effective at representing one-to-many relationships
  - **(7)** Many data relationships do not fit the one-to-many model
  - **(8)** If the data relationships change, this can require significant redesign of the database
- **k.** Network Model
  - **(1)** Developed from the hierarchical model
  - **(2)** The child node is not limited to one parent
  - **(3)** This makes it possible to represent many-to-many relationships
  - **(4)** The presence of multiple links between data does make it more difficult if data relationships change and redesign is necessary
- **l.** Relational Database Model (RDM)
  - **(1)** Relational database model consist of a series of files set up as tables
  - **(2)** Each column represents an attribute
  - **(3)** Each row is a record
  - **(4)** Another name for a row is tuple
  - **(5)** The intersection of the row and the column is a cell

      - (6) The datum in the cell is the manifestation of the attribute for that record
      - (7) Each cell may contain only one piece of datum
      - (8) The datum must be atomic or broken down into its smallest format
      - (9) The relationships represented are linear and only relate one data element to another
      - (10) A relational database joins any two or more files and generates a new file from the records that meets the matching search criteria
      - (11) A relational database consists of multiple tables
      - (12) It is possible to build a simple database with one table
      - (13) This type of database is a flat file
      - (14) An Excel spreadsheet is an example of a flat file
      - (15) This approach is good if you have a relatively small amount of data and simple questions
      - (16) Excel has a table feature that permits one to delete and add fields, add records, remove duplicate rows, sort data, filter data, and create aggregate subsets of data
   - **m.** Object-oriented model
      - (1) Evolved because the relational model has limited ability to deal with binary large objects or BLOBs
      - (2) BLOBs are complex data types such as images, sounds, spreadsheets, or text messages
      - (3) They are large non-atomic data with parts and subparts that a relational database cannot easily represent
      - (4) The entity as well as attributes of the entity is stored with the object
      - (5) An object can store other objects as well
      - (6) The data definition includes both the object and its attributes
      - (7) The ability to handle non-atomic complex data and inheritance attributes are major advantages in healthcare computing
   - **n.** New models
      - (1) Massively Parallel Processing (MPP)
      - (2) Column-orient database
      - (3) Stream processing (ESP or CEP)
      - (4) Key-value storage (MapReduces)

8. Database life cycle
   - **a.** Recursive pattern to the development
   - **b.** The number of steps can vary
   - **c.** A five-step approach
      - (1) Initiation—Identifies a need or problem and sees the development of a DBMS as a possible solution
      - (2) Planning and analysis—Begins with an assessment of the user's view and the development of the conceptual model and ends with the logical model
      - (3) Detailed systems design and development—Begins with the selection of the physical model
      - (4) Implementation—Includes training the users, testing the system, finalizing the procedure manual, piloting the DBMS, and "going live"
      - (5) Evaluation and maintenance—Early evaluations have limited value. The first evaluations should be informal and focus on troubleshooting. Maintenance includes regular back-up of the database

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Data to Information

1. Common database operations
   - **a.** Data input operations
      - (1) Input new data
      - (2) Update data
      - (3) Change or modify data
   - **b.** Data processing processes
      - (1) The purpose is to extract information
      - (2) Discover new meanings
      - (3) Reorder data
   - **c.** Data output operations
      - (1) Online and written reports
      - (2) Processed data as charts and graphs

2. Data warehouses
   - **a.** A large collection of data imported from several different systems into one database
   - **b.** The source of the data includes not only internal data from the institution
   - **c.** Can also include data from external sources
   - **d.** Smaller collections of data are data marts
      - (1) One might develop a data mart with the historical data of a department or a small group of departments
      - (2) One might also develop a data mart by exporting a subset of the data from the data warehouse
   - **e.** Purposes of a data warehouse
      - (1) Spares users from the need to learn several different applications
      - (2) Makes it possible to separate the analytical and operational processing
      - (3) Provides an architectural design for the data warehouse that supports decisional information needs
      - (4) The user can slice and dice the data from different angles and at different levels of detail
   - **f.** Functions of a data warehouse
      - (1) Must be able to extract data from the various computer systems and import those data into the data warehouse
      - (2) Must function as a database able to store and process the data in the database
      - (3) Must be able to deliver the data in the warehouse back to the users in the form of information

- **g.** Support activities and provide these benefits
  - **(1)** End user self-service of their data needs freeing IT for other tasks
  - **(2)** Access to clinical and financial data in one repository
  - **(3)** Creation of standardized reports of core measures, quality indicators, and pay-for-performance results
  - **(4)** Identification of casual relationships of diseases, symptoms, treatments
  - **(5)** Focus on common goals regarding data management
  - **(6)** Negotiating with insurance companies
  - **(7)** Reporting on EMR user log data for tracking policy compliance

3. Data analysis and presentation

- **a.** Analytics
  - **(1)** The process one uses to make realistic, quality decisions using the available data
  - **(2)** This means that data and its analysis guides the decision making process
  - **(3)** Analysis involves a systematic examination and evaluation of data to uncover interrelationships within the data, thereby producing new insights and information
  - **(4)** The process usually involves breaking the data into smaller parts to better understand the area of concern
  - **(5)** The term business intelligence (BI) when the data includes administrative data that relates to the day-to-day operation of the institution, as well as strategic or long range planning data
  - **(6)** The analysis in this case includes a host of statistics that one uses in analyzing the wealth of business data
  - **(7)** These statistical tests can include simple descriptive statistics like means, averages, frequencies, as well as more complex operations such as regression analysis, correlations, and predictions
  - **(8)** Depending on the size of the database, one can use simple tools like spreadsheets or other tools designed for larger data sets
  - **(9)** Data tools can be free or must be acquired for a fee
  - **(10)** R Project which is an environment for data analysis and visualization
  - **(11)** DataWrangler for cleaning and rearranging data
  - **(12)** CSVKit for working with .csv files
  - **(13)** An example of a tool for a large data set is Hadoop
- **b.** Dashboards
  - **(1)** Dashboards comes from the automobile and airline industry and involves the synthesis and presentation of data in a visual format
  - **(2)** Systems process data and then present it in a visual layout so that one can easily visualize the information and the interrelationships for the purpose of decision making and benchmarking
  - **(3)** A dashboard "…is a visual display of the most important information needed to achieve one or more objectives, consolidated and arranged on a single screen so the information can be monitored at-a-glance"

4. Data quality

- **a.** In a data warehouse, data is entered once, but can be used many times by many users for a number of different purposes
- **b.** The quality of the data on entry takes on a whole new level of importance
- **c.** The concept of data ownership changes
- **d.** When dealing with a department information system, the department is usually seen as owning the data and being responsible for the quality of that data
- **e.** The concept of a data steward is appropriate when thinking about who is responsible for the data in a data warehouse
  - **(1)** "Data stewardship is the aspect of data governance that focuses on providing the appropriate access to users, helping users to understand the data, and taking ownership of data quality
  - **(2)** Without appropriate stewardship, even the best infrastructures become underutilized and poorly understood by knowledge workers who could be generating value with the data every day"
  - **(3)** A data steward does not own the data but ensures its quality
  - **(4)** The data steward is the "keeper of the data," not the "owner of the data"
- **f.** The National Committee on Vital and Health Statistics (NCVHS) under the authorship of Kanaan and Carr issued a primer titled "Health Data Stewardship: What, Why, Who, How: An NCVHS Primer"
- **g.** In this primer four key principles were identified with implications for nurses:
  - **(1)** Individual rights to access and to correct their own data. This includes building trust by making the data transparent and by requiring consent for this data use
  - **(2)** A data steward with responsibilities for data quality, for identifying the purpose in using specific data, application of good statistical practices, and so forth
  - **(3)** Appropriate safeguards and controls to ensure confidentiality, integrity, and protection of the data from unauthorized access, use, or disclosure
  - **(4)** Policies for appropriate use and accountability for those using the data
- **h.** "Given the potential for both benefits and risks from the sharing and reuse of health data, consensus is building in the United States and beyond that everyone who touches individual health data for any purpose—healthcare, research, quality assessment, population health monitoring, payment, and more—must understand and practice data stewardship"

5. The development of big data

- **a.** Big data is the term used to describe the amount of data generated from digital sources
- **b.** The 3-Vs—volume, velocity, and variety—describe big data
  - **(1)** Volume relates to the amount of data that are generated with increasing use of technology
  - **(2)** Velocity means the frequency of data delivery
  - **(3)** Variety means the forms in which data exists

   - **c.** In healthcare this means data in unstructured text format, data from monitoring devices, images, as well as other sources
   - **d.** These data are more unstructured than one typically finds in a database
   - **e.** The biggest issue in healthcare is how to tap the potential value of these data
   - **f.** Big data present new challenges related to how healthcare data are organized, retrieved, and used to personalize patient care

Data/Information to Knowledge (KDD)

1. Data mining
   - **a.** Traditional methods of retrieving information from databases no longer work with the sheer amount of data that the healthcare industry is producing
   - **b.** One can generate and store data far faster than one can analyze and understand it
   - **c.** We can refer to the process of extracting information and knowledge from large-scale databases as knowledge discovery and data mining (KDD)
   - **d.** The purpose of data mining is to find previously unknown patterns and trends that will assist in providing quality care, predicting best treatment choices, and utilizing health resources in a cost-effective manner
   - **e.** A traditional approach to the KDD development includes a seven-step process
     - **(1)** Task analysis
     - **(2)** Data selection
     - **(3)** Data cleaning
     - **(4)** Data transformation
     - **(5)** Data mining
     - **(6)** Pattern interpretation and evaluation
     - **(7)** Deployment
   - **f.** Bagga and Singh propose a three-step process
     - **(1)** Pre-processing
     - **(2)** Data mining
     - **(3)** Post processing
   - **g.** Some examples of data mining techniques include
     - **(1)** Rule set classifiers like IF conditions THEN conclusion
     - **(2)** Decision tree algorithms
     - **(3)** Logistic regression analysis
     - **(4)** Neuro-fuzzy techniques
     - **(5)** Memory-based reasoning
2. Benchmarking
   - **a.** Benchmarking is a process where one compares outcome measures with industry averages
   - **b.** The process of benchmarking means to determine the goal or objectives, define appropriate indicators, collect data, and determine results
3. Outcome probabilities
   - **a.** The concept of outcome probability is built on the statistical concept of probability
   - **b.** If this concept is transferred to nursing the question becomes what is the probability that a certain intervention will result in a certain outcome
   - **c.** Nursing care, as is true in healthcare in general, many of the outcomes are long term and influenced by a variety of factors

Wisdom

1. Knowledge application
   - **a.** Decision support systems produce knowledge from information
   - **b.** Expert systems use that knowledge base and transform it to produce wisdom
   - **c.** With the emergence of supercomputers in the 1990s nursing had a unique opportunity to further nursing's knowledge and practice
   - **d.** A proposed theory of nursing knowledge/wisdom uses the formula NKW (IB) = P, where
     - **(1)** NK is nursing knowledge
     - **(2)** W is wisdom
     - **(3)** "IB is the individual nurses integration and synthesis of nursing knowledge through cognitive, psychomotor, and affective/spiritual domain of self"
     - **(4)** P represents the breadth and depth of practice
   - **e.** Expert systems require a sound knowledge base as one of its components
2. Expert support/systems
   - **a.** Expert systems represent the present and future vanguard of nursing informatics
   - **b.** These systems aim to help make the nurse "more intelligent" in providing quality care based on evidence
   - **c.** Expert systems use artificial intelligence (AI) to model the decisions an expert nurse would make
   - **d.** They provide the "best decision" recommendation based on what an expert nurse would do unlike decision support systems that provide several options from which the nurse selects
   - **e.** Some of the advantages of expert systems include:
     - **(1)** Provide a solution more quickly than humans
     - **(2)** Reduce waste and cut costs
     - **(3)** Improve patient care by sharing the knowledge and wisdom of human experts
   - **f.** As early as the mid-1980s and early 1990s articles were published describing the components of expert systems and uses in nursing
   - **g.** Expert systems have four main components
     - **(1)** Natural language
     - **(2)** Knowledge base
     - **(3)** A database
     - **(4)** An inference engine as well as a means of capturing expert knowledge and an explanation to the end user as to the rationale behind the recommendation
   - **h.** A current example is IBM's Watson that understands natural language and can process large amounts of data quickly using rules and machine learning

  i. In the medical field Watson can diagnose and suggest a treatment option, search the Internet for new information in real time, and diagnose conditions in some cases with more accuracy than an expert doctor

3. Evidence-based practice
   a. The concept of evidence-based practice is widely accepted across each of the healthcare disciplines
   b. The reality of providing evidence-based care at the point of care is often an elusive goal
   c. With the advent of big data and data analytics techniques along with expert systems capable of analyzing unstructured data and using natural language to present the resulting conclusions, real time evidence-based practice is a potential reality
   d. But for nursing to achieve this potential reality nursing data, information, knowledge, and wisdom must consistently be included in building automated healthcare information systems

SUMMARY

- This chapter describes data processing
- The focus of the chapter is on understanding concepts and issues necessary to effectively use database systems in healthcare
- The chapter begins by discussing the difference between data and information. It describes the process of using an information system to produce information from data
- The chapter explains data structures and models and reviews the purpose(s), structures, and functions of automated database systems
- The chapter outlines the life cycle of an automated database system
- Building on an understanding of databases, the chapter explores concepts and issues that relate to data warehouses and knowledge discovery within large data sets
- The chapter concludes by describing how an understanding of databases is key to understanding the data to wisdom continuum in nursing

Teaching Tip
Ask the students to report what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe the data-related implications for data and database systems within the data to wisdom continuum
- Explain file structures and database models
- Describe the purpose, structures, and functions of database management systems (DBMSs)
- Outline the life cycle of a database system
- Explore concepts and issues related to data warehouses, big data, and dashboards
- Explain knowledge discovery in databases (KDD) including data mining, data analytics, and benchmarking

Teaching Tip
Ask the students to define the keywords

- Big data
- Dashboard
- Data
- Database
- Data analytics
- Data mining
- Data warehouse
- Information
- Knowledge
- Knowledge discovery in databases (KDD)
- Wisdom

CHAPTER REVIEW QUESTIONS

Question 6.1: What are the four elements of the Nelson continuum?

a. Knowledge, data, wisdom, and pattern
b. Data, wisdom, information, and knowledge
c. Context, pattern, data, and wisdom
d Wisdom, data, raw facts, and information

Question 6.2: What defines a database?

a. Method of coding data
b. Narrative text that cannot be searched
c. Organized collection of related data
d. Free form data storage

Question 6.3: What are considered to be computer-based data types?

a. Logic, numeric, and database
b. Numeric, alphanumeric, and HL7
c. Alphanumeric, numeric, and logic
d. Internet, logic, and numeric

Question 6.4: What are the three parts of a database management system (DBMS)?

a. Data, designed database, and query language
b. Software, browser, and hardware equipment
c. Computer program, database, and browser
d. Database, browser, and HL7

Question 6.5: What is a database model?

a. It identifies the uses of the data entities
b. Is the basis for how the data are stored, organized, and accessed
c. It describes the data attributes
d. It describes how the data are used

Question 6.6: What are the four major physical database models used in HIT systems?

- **a.** Networked, hierarchical, logical, and conceptual
- **b.** Object oriented, relational, logical, and hierarchical
- **c.** Networked, conceptual, logical, object oriented
- **d.** Hierarchical, relational, networked, and object oriented

Question 6.7: What are the three most common DBMS operations performed in any computer-based information system?

- **a.** Data processing processes, data storage design, and data retrieval
- **b.** Data retrieval, online processing processes, and data storage design
- **c.** Data input operations, data processing processes, and data output operations
- **d.** Data output operations, data storage design, and online processing processes

Question 6.8: What are the three types of programs needed to manage a data warehouse?

- **a.** Extract data, input data, and relational data
- **b.** Retrieve data, store and aggregate data, input data
- **c.** Extract data, store, process and aggregate data, and deliver data/information
- **d.** Define data, relational data, and deliver data/information

Question 6.9: How are dashboards used in HIT systems?

- **a.** It involves the synthesis and presentation in a visual format
- **b.** It takes the unprocessed data and presents their data elements
- **c.** Is a model that presents the concepts in the database
- **d.** It is a tool to present data sets

Question 6.10: What is one reason why “data mining” is used in the healthcare industry?

- **a.** Used to evaluate treatments rendered in healthcare
- **b.** Used to analyze health resources in a cost-effective manner
- **c.** Used to find unknown patterns that assist in providing quality care
- **d.** Used to demonstrate quality outcomes

ANSWERS AND EXPLANATIONS

Question 6.1: (b) Data, wisdom, information, and knowledge. The Nelson continuum that expands the original concept of nursing informatics which was depicted as the processing data by computer to generate information which led to knowledge.

Question 6.2: (c) Organized collection of related data. Data is discussed as digital data that can be described as data at rest, in motion, and in use. Electronic databases are replacing paper databases such as card catalogues in libraries.

Question 6.3: (c) Alphanumeric, numeric, and logic. Alphanumeric generally refers to letters combined with numbers; whereas numeric refers to only numbers, and can perform numeric functions; logic data represents two options: True or False (1 or 2, or On or Off), which can take the form of a file or image.

Question 6.4: (a) Data, designed database, and query language. DBMS are computer programs that are used to input, store, modify, process, and access data in a database. Before you can use a DBMS you need to create a database. Thus a functioning DBMS consists of three interacting parts: data, database, and query language. The query language is used to access the data.

Question 6.5: (b) Is the basis for how the data are stored, organized, and accessed. These were named in 1975 by ANSI. They further described that models have three main types: conceptual design, logical design, or physical design.

Question 6.6: (d) Hierarchical, relational, networked, and object oriented. The four primary approaches to the development of a physical data model are: a hierarchical database model represents one-to-one or one-to-many relationships; a network model is used to represent many to many relationships; a relational database model is used to join any two or more files and generates a new file from the records—it consists of multiple tables; and an object-oriented model includes both the object and its attributes expanding the capability of a relational database.

Question 6.7: (c) Data input operations, data processing processes, and data output operations. The three common operations: data input, data processing, and data output represent the input of the entry of new data, whereas the data processing directs the actions that the computer performs on the entered data, and the data output represents the presentation of the processed data in charts, grafts, or reports.

Question 6.8: (c) Extract data, store, process, and aggregate data, and deliver data/information. The development of a data warehouse is based on several goals and/or purposes. It is usually designed to provide different views of the data. It must function as a database able to store, process, and aggregate the data. The warehouse database must be structured so that the data can be delivered back to the users for processing into information. It can support a variety of activities such as create standards, etc.

Question 6.9: (a) It involves the synthesis and presentation in a visual format. A dashboard is a concept derived from the automobile industry in that it involves the synthesis of the data in a visual format. At a glance you can see several related variables critical to a patient activity such as presenting all clinical performance indicators together.

Question 6.10: (c) Used to find unknown patterns that assist in providing quality care. It means to apply the computational techniques to find the pattern and trends. It can help establish rule setting decision trees etc. (That is IF this is so then you do THAT.)

7

Health Data Standards: Development, Harmonization, and Interoperability

• OBJECTIVES

1. Discuss the need for health data standards.
2. Describe the standards development process and related organizations.
3. Delineate the importance of health information exchange and interoperability.
4. Describe current health data standards initiatives.
5. Explore the business value of health data standard.

• KEY WORDS

Standards
Health information exchange
Knowledge representation
Interoperability
Clinical integration
Terminology

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Why are standards important? Can you give an example of a standard? Can you give an example of interoperability? Why is interoperability important? Why are standards important in healthcare? Why is interoperability important in healthcare? Why are terminologies important in healthcare?

For a WIIFM statement, say to the class, "This chapter examines health data standards in terms of the following topic areas:

Need for health data standards
Standards development process, organizations, and categories
Knowledge representation
Standards coordination and harmonization
Health information exchange and interoperability
Health data standards initiatives
Business value of health data standards"

As a nurse, it is important to understand standards, the standards development process, health information exchange, interoperability as well as terminologies and vocabularies.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites related to the chapter topics

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Nursing Informatics Technologies Health Data Standards: Development, Harmonization, and Interoperability

Teaching Tip

Provide this content as an introduction for the students Standards are foundational to the development, implementation, and exchange of electronic health records (EHRs). The effectiveness of healthcare delivery is dependent on the ability of clinicians to securely access health information when and where it is needed. The capability of exchanging health information across organizational and system boundaries, whether between multiple departments within a single institution or among a varied cast of providers, payers, regulators, and others, is essential. A harmonized set of rules and definitions, both at the level of data meaning as well as at the technical level of data exchange, is needed to make this possible. Additionally, there must be a sociopolitical structure in place that recognizes the benefits of shared information and incentivizes the adoption and implementation of such standards to improve population health management.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Introduction to Health Data Standards

1. The ability to communicate in a way that ensures the message is received and the content is understood is dependent on standards
2. Data standards are intended to reduce ambiguity in communication so that the actions taken based on data are consistent with the actual meaning of that data
3. The Health Information Technology for Economic and Clinical Health (HITECH) Act is driving US efforts to transform healthcare through the meaningful use of health data
4. This goal will be advanced through a phased-in series of improved clinical data capture processes that support more rigorous quality measures and improvements
5. This transformation requires data capture and sharing and advanced clinical processes
6. Will enable improved health outcomes
7. This ultimate end state can only be achieved through
    a. The organized structuring and effective use of information to support better decision making
    b. More effective care processes
    c. Thus improving health outcomes and reducing costs
8. While current information technology (IT) is able to move and manipulate large amounts of data
9. Current IT is not as proficient in dealing with ambiguity in the structure and semantic content of that data
10. The term *health data standards* is generally used to describe those standards having to do with the structure and content of health information
11. It may be useful to differentiate data from information and knowledge
12. Data are the fundamental building blocks on which healthcare decisions are based
    a. Data are collections of unstructured, discrete entities (facts) that exist outside of any particular context
    b. When data are interpreted within a given context and given meaningful structure within that context, they become information
13. The term *interoperability* describes the extent to which systems and devices can exchange data, and interpret that shared data
14. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user
15. When information from various contexts is aggregated following a defined set of rules, it becomes knowledge and provides the basis for informed action
16. Data standards represent both data and their transformation into information
17. Data analysis generates knowledge, which is the foundation of professional practice standards
18. Standards are created by several methods
    a. A group of interested parties comes together and agrees upon a standard
    b. The government sanctions a process for standards to be developed
    c. Marketplace competition and technology adoption introduces a de facto standard
    d. A formal consensus process is used by a standards development organization (SDO)
19. The standards development process typically begins with a use case or business need that describes a system's behavior as it responds to a request that originates from outside of that system
    a. Technical experts then consider what methods, protocols, terminologies, or specifications are needed to address the requirements of the use case
    b. An open acceptance or balloting process is desirable to ensure that the developed standards have representative stakeholder input, which minimizes bias and encourages marketplace adoption and implementation
20. Legislated, government-developed standards are able to gain widespread acceptance by virtue of their being required by either
    a. Regulation
    b. Or in order to participate in large, government-funded programs, such as Medicare
    c. Government-developed standards are in the public domain
    d. They are available at little or no cost
    e. Can be incorporated into any information system
    f. They are often developed to support particular government initiatives
    g. May not be as suitable for general, private sector use
    h. Given the bureaucratic overhead attached to the legislative and regulatory process, it is likely that they will lag

behind changes in technology and the general business environment

21. Standards developed by SDOs are typically consensus-based and reflect the perspectives of a wide variety of interested stakeholders
   - **a.** They are generally not tied to specific systems
   - **b.** They tend to be robust and adaptable across a range of implementation

22. Most SDOs are nonprofit organizations
   - **a.** Rely on the commitment of dedicated volunteers to develop and maintain standards
   - **b.** This often limits the amount of work that can be undertaken

23. The consensus process can be time consuming and result in a slow development process, which does not always keep pace with technologic change
   - **a.** Perhaps the most problematic aspect of consensus-based standards is that there is no mechanism to ensure that they are adopted by the industry
   - **b.** Usually there is little infrastructure in place for SDOs to actively and aggressively market them
   - **c.** This has resulted in the development of many technically competent standards that are never implemented

24. The US Standards Strategy states that, "The goal of all international standards forums should be to achieve globally relevant and internationally recognized and accepted standards that support trade and commerce while protecting the environment, health, safety, and security"

25. There are a number of drivers in the current standards landscape that are working to accelerate health data standards adoption and implementation through innovative efforts and incentives that address this charge

Teaching Tip
Ask the students to state their understanding of health data standards and interoperability.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Standards Categories

Teaching Tip
Provide the following information to the students, four broad areas are identified to categorize health data standards (Department of Health and Human Services, 2010). Transport standards are used to establish a common, predictable, secure communication protocol between systems. Vocabulary standards consist of nomenclatures and code sets used to describe clinical problems and procedures, medications, and allergies. Content exchange standards and value sets are used to share clinical information such as clinical summaries, prescriptions, and structured electronic documents. Security standards are used to safeguard the transmission of health data through authentication and access control.

1. Transport standards

Teaching Tip
Provide the following information, transport standards primarily address the format of messages that are exchanged between computer systems, document architecture, clinical templates, the user interface, and patient data linkage (Committee on Data Standards for Patient Safety, 2004). To achieve data compatibility between systems, it is necessary to have prior agreement on the syntax of the messages to be exchanged. The receiving system must be able to divide the incoming message into discrete data elements that reflect what the sending system wishes to communicate. The following section describes some of the major SDOs involved in the development of transport standards.

a. ***Accredited Standards Committee X12N/Insurance***
   - **(1)** Accredited Standards Committee (ASC) X12N has developed a broad range of electronic data interchange (EDI) standards to facilitate electronic business transactions
   - **(2)** In the healthcare arena, X12N standards have been adopted as national standards for such administrative transactions as claims, enrollment, and eligibility in health plans, and first report of injury under the requirements of the Health Insurance Portability and Accountability Act (HIPAA)
   - **(3)** Due to the uniqueness of health insurance and the varying policies for protection of personal health information from country to country, these standards are primarily used in the United States
   - **(4)** HIPAA directed the Secretary of the Department of Health and Human Services (HHS) to adopt standards for transactions to enable health information to be exchanged electronically
   - **(5)** The Administrative Simplification Act (ASA), one of the HIPAA provisions, requires standard formats to be used for electronically submitted healthcare transactions
   - **(6)** The American National Standards Institute (ANSI) developed these
   - **(7)** The ANSI X12N 837 Implementation Guide has been established as the standard of compliance for claims transactions

b. ***Institute of Electrical and Electronic Engineers***
   - **(1)** The Institute of Electrical and Electronic Engineers (IEEE) has developed a series of standards known collectively as P1073 Medical Information Bus (MIB)
   - **(2)** Support real-time, continuous, and comprehensive capture and communication of data from bedside medical devices

Teaching Tip
Provide the following examples, medical devices found in intensive care units, operating rooms, and emergency departments.

   - **(3)** These data include physiologic parameter measurements and device settings
   - **(4)** IEEE standards for IT focus on telecommunications and information exchange between systems, including local and metropolitan area networks

  - **(5)** The IEEE 802.xx suite of wireless networking standards, supporting local and metropolitan area networks, has advanced developments in the communications market
  - **(6)** The most widely known standard, 802.11
  - **(7)** 802.11, commonly referred to as Wi-Fi, allows anyone with a "smart" mobile device or a computer to connect to the Internet wirelessly through myriad access points
  - **(8)** IEEE 11073 standards are designed to help healthcare product vendors and integrators create interoperable devices and systems for disease management, health, and fitness
  - **(9)** The growing IEEE 11073 family of standards is intended to enable interoperable communication for traditional medical devices, as well as personal health devices

- **c.** ***National Electrical Manufacturers Association***
  - **(1)** The National Electrical Manufacturers Association (NEMA), in collaboration with the American College of Radiologists (ACR) and others, formed DICOM (Digital Imaging and Communications in Medicine)
  - **(2)** To develop a generic digital format and a transfer protocol for biomedical images and image-related information
  - **(3)** DICOM enables the transfer of medical images in a multi-vendor environment
  - **(4)** DICOM facilitates the development and expansion of picture archiving and communication systems (PACS)
  - **(5)** The specification is usable on any type of computer system and supports transfer over the Internet
  - **(6)** The DICOM standard is the dominant international data interchange message format in biomedical imaging
  - **(7)** The Joint NEMA/The European Coordination Committee of the Radiological and Electromedical Industry/Japan Industries Association of Radiological Systems (COCIR/JIRA) Security and Privacy Committee (SPC) issued a white paper that provides a guide for vendors and users on how to protect health information systems against viruses, Trojan horses, denial of service attacks, Internet worms, and related forms of so-called malicious software

- **d.** ***World Wide Web Consortium***
  - **(1)** The World Wide Web Consortium (W3C) is the main international standards organization for development of the World Wide Web (abbreviated WWW or W3)
  - **(2)** W3C also publishes XML (Extensible Markup Language)
  - **(3)** XML is a set of rules for encoding documents in machine-readable format
  - **(4)** XML is most commonly used in exchanging data over the Internet
  - **(5)** It is defined in the XML 1.0 Specification produced by the W3C and several other related specifications
  - **(6)** All of which are available in the public domain
  - **(7)** XML's design goals emphasize simplicity, generality, and usability over the Internet,
  - **(8)** Which also makes it desirable for use in cross-enterprise health information exchange
  - **(9)** It is a textual data format, with strong support for the languages of the world
  - **(10)** XML's design focuses on documents
  - **(11)** XML is widely used for the representation of arbitrary data structures such as Web Services
  - **(12)** Web Services use XML messages that follow the Simple Object Access Protocol (SOAP) standard and have been popular with traditional enterprises
  - **(13)** Other transport protocols include the Representational State Transfer (REST) architectural style, which was developed in parallel with the Hypertext Transfer Protocol (HTTP) used in Web browsers
  - **(14)** The largest known implementation of a system conforming to the REST architectural style is the World Wide Web

- **e.** ***Communication protocols***
  - **(1)** In telecommunications, a protocol is a system of digital rules for data exchange within or between computers
  - **(2)** When data are exchanged through a computer network, the rules system is called a network protocol
  - **(3)** Communication systems use well-defined formats for exchanging messages
  - **(4)** A protocol must define the syntax, semantics, and synchronization of the communication
  - **(5)** Communication protocols include the Transmission Control Protocol/Internet Protocol (TCP/IP)
  - **(6)** Which is the suite of communications protocols used to connect hosts on the Internet
  - **(7)** TCP/IP is built into the UNIX operating system
  - **(8)** Is used by the Internet, making it the de facto standard for transmitting data over networks
  - **(9)** File Transfer Protocol (FTP) is a standard network protocol used to transfer files from one host to another host over a TCP-based network, such as the Internet
  - **(10)** Simple Mail Transfer Protocol (SMTP) is an Internet standard for electronic mail (e-mail) transmission

2. Vocabulary standards

Teaching Tip

Provide the following information, a fundamental requirement for effective communication is the ability to represent concepts in an unambiguous fashion between both the sender and receiver of the message. Natural human languages are incredibly rich in their ability to communicate subtle differences in the semantic content, or meaning, of messages. While there have been great advances in the ability of computers to process natural language, most communication between health information systems relies on the use of structured vocabularies, terminologies, code sets, and classification systems to represent health concepts. Standardized terminologies enable data collection at the point of care, and retrieval of data, information, and knowledge in support of clinical practice. The following examples describe several of the major systems.

a. ***Current Procedural Terminology***

  (1) The Current Procedural Terminology (CPT) code set

  (2) Maintained by the American Medical Association (AMA)

  (3) Accurately describes medical, surgical, and diagnostic services

  (4) It is designed to communicate uniform information about medical services and procedures among physicians, coders, patients, accreditation organizations, and payers

  (5) Used for administrative, financial, and analytical purposes

  (6) The current version is the CPT 2013

  (7) Contains descriptive terms and codes

  (8) Contains modifiers, notes, and guidelines to facilitate correct usage

  (9) Primarily used in the United States for reimbursement purposes

  (10) It has also been adopted for other data purposes

b. ***International Statistical Classification of Diseases and Related Health Problems: Ninth Revision and Clinical Modifications***

  (1) The International Statistical Classification of Diseases and Related Health Problems: Ninth Revision and Clinical Modifications (ICD-9-CM)

  (2) Is a version of a mortality and morbidity classification used since 1979 for reporting in the United States

  (3) It is widely accepted and used in the healthcare industry

  (4) It has been adopted for a number of purposes, including data collection, quality-of-care analysis, resource utilization, and statistical reporting

  (5) ICD-9 procedure codes are the acceptable HIPAA code set for inpatient claims

  (6) Healthcare Common Procedure Coding System/Current Procedural Terminology (HCPCS/CPT) codes are the valid set for outpatient claims

c. ***International Statistical Classification of Diseases and Related Health Problems: Tenth Revision***

  (1) The International Statistical Classification of Diseases and Related Health Problems: Tenth Revision (ICD-10)

  (2) Is the most recent revision of the ICD classification system for mortality and morbidity

  (3) Is used worldwide

  (4) In addition to diagnostic labels, the ICD-10 also encompasses nomenclature structures

  (5) It is proposed that the ICD-9 code sets used to report medical diagnoses and inpatient procedures will be replaced by ICD-10 code sets

  (6) The transition to ICD-10 is required for everyone covered by HIPAA

  (7) However, the change to ICD-10 does not affect CPT coding for outpatient procedures and physician services

  (8) The transition to ICD-10-CM and ICD-10 Procedural Coding System (ICD-10-PCS) is anticipated to improve the capture of health information

  (9) The transition to ICD-10-CM and ICD-10 Procedural Coding System (ICD-10-PCS) will bring the United States in step with coding systems worldwide

  (10) For those who prepare appropriately, leveraging the ICD-10 investment will allow organizations to move beyond compliance to achieve competitive advantage (Bowman, 2008)

  (11) Moving to the new code sets will improve efficiencies

  (12) Moving to the new code set will lower administrative costs due to replacement of a dysfunctional classification system

d. ***Nursing and other domain-specific terminologies***

  (1) The American Nurses Association (ANA) has spearheaded efforts to coordinate the various minimum data sets and standardized nursing terminologies

  (2) The ANA has recognized the following nursing terminologies that support nursing practice

    i. ABC Codes

    ii. Clinical Care Classification

    iii. International Classification of Nursing Practice

    iv. Logical Observation Identifiers Names and Codes (LOINC)

    v. North American Nursing Diagnosis Association (NANDA)

    vi. Nursing Interventions Classification (NIC)

    vii. Nursing Outcome Classification (NOC)

    viii. Nursing Management Minimum Data Set

    ix. Nursing Minimum Data Set

    x. Omaha System

    xi. Patient Care Data Set (retired)

    xii. Perioperative Nursing Data Set

    xiii. SNOMED-CT

  (3) These standard terminologies enable knowledge representation of nursing content

  (4) Nurses use assessment data and nursing judgment to determine nursing diagnoses, interventions, and outcomes

  (5) These elements can be linked together using standards to represent nursing knowledge

Teaching Tip

Ask the students to identify any nursing terminology standards used in their healthcare organization. Ask the students to describe how the terminologies are used.

e. ***RxNorm***

  (1) RxNorm is a standardized nomenclature for clinical drugs and drug delivery devices

  (2) Produced by the National Library of Medicine (NLM)

  (3) Every drug information system follows somewhat different naming conventions

(4) A standardized nomenclature is needed for the consistent exchange of information, not only between organizations, but even within the same organization

Teaching Tip

Use the following example, a hospital may use one system for ordering and another for inventory management. Still another system might be used to record dose adjustments or to check drug interactions.

(5) The goal of RxNorm is to allow the various systems using different drug nomenclatures to share data efficiently at the appropriate level of abstraction

(6) RxNorm contains the names of prescription and many nonprescription formulations that exist in the United States

(7) RxNorm contains the names of devices that administer the medications

f. ***Unified Medical Language System***

(1) The Unified Medical Language System (UMLS) consists of

- **i.** A metathesaurus of terms and concepts from dozens of vocabularies
- **ii.** A semantic network of relationships among the concepts recognized in the metathesaurus
- **iii.** An information sources map of the various biomedical databases referenced

(2) There are specialized vocabularies, code sets, and classification systems for almost every practice domain in healthcare

(3) Most of these are not compatible with one another

(4) Much work needs to be done to achieve usable mapping and linkages between them

(5) There have been a number of efforts to develop mapping and linkages among various code sets, classification systems, and vocabularies

(6) One of the most successful is the UMLS project undertaken by the NLM

(7) The NLM supports the development, enhancement, and distribution of clinically specific vocabularies to facilitate the exchange of clinical data to improve retrieval of health information

(8) In 1986, the NLM began an ambitious long-term project to map and link a large number of vocabularies from a number of knowledge sources to allow retrieval and integration of relevant machine-readable information

(9) The NLM is the central coordinating body for clinical terminology standards within HHS (National Library of Medicine, 2010)

(10) The NLM works closely with the Office of the National Coordinator for Health Information Technology (ONC)

(11) The NLM's efforts are aligned with the goal of the President and HHS Secretary to achieve nation-wide implementation of an interoperable health IT infrastructure to improve the quality and efficiency of healthcare

(12) Other domain-specific terminologies include

- **i.** Current Dental Terminology (CDT)
- **ii.** International Medical Terminology (IMT)
- **iii.** Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. Content standards

Teaching Tip

Provide the following information, content standards are related to the data content within information exchanges. Information content standards define the structure and content organization of the electronic message's or document's information content. They can also define a "package" of content standards (messages or documents). In addition to standardizing the format of health data messages and the lexicons and value sets used in those messages, there is widespread interest in defining common sets of data for specific message types. The concept of a *minimum data set* is defined as "a minimum set of items with uniform definitions and categories concerning a specific aspect or dimension of the healthcare system which meets the essential needs of multiple users."

A related concept is that of a *core data element*. It has been defined as "a standard data element with a uniform definition and coding convention to collect data on persons and on events or encounters." Core data elements are seen as serving as the building blocks for well-formed minimum data sets and may appear in several minimum data sets. The following are some examples of minimum, or core, data sets currently in use. As with code sets, professional specialty groups are often the best source for current information on minimum data set development efforts. A number of SDOs have been increasingly interested in incorporating domain-specific data sets into their messaging standards.

a. ***American Society for Testing and Materials***

(1) The American Society for Testing and Materials (ASTM) is one of the largest SDOs in the world and publishes standards covering all sectors in the economy

(2) More than 13,000+ ASTM standards are used worldwide to improve product quality, enhance safety, and facilitate trade

(3) The ASTM Committee E31 on Healthcare Informatics has developed a wide range of standards supporting the electronic management of health information

b. ***Clinical Data Interchange Standards Consortium***

(1) The Clinical Data Interchange Standards Consortium (CDISC) is a global, multidisciplinary consortium

(2) Has established standards to support the acquisition, exchange, submission, and archive of clinical research data and metadata

(3) CDISC develops and supports global, platform-independent data standards that enable information system interoperability to improve medical research and related areas of healthcare

Teaching Tip

Provide the following example, the Biomedical Research Integrated Domain Group (BRIDG) Model, which is a domain analysis model representing protocol-driven biomedical and clinical research. The BRIDG model emerged from an unprecedented collaborative effort among clinical trial experts from CDISC, the National Institutes of Health (NIH)/National Cancer Institute (NCI), the Food and Drug Administration (FDA), HL7, and other volunteers.

This structured information model is being used to support development of data interchange standards and technology solutions that will enable harmonization between the biomedical and clinical research and healthcare arenas.

c. ***Health Level Seven***

(1) Health Level Seven (HL7) is an SDO that develops standards in multiple categories including transport and content

(2) HL7 standards focus on facilitating the exchange of data to support clinical practice both within and across institutions

(3) HL7 standards cover a broad spectrum of areas for information exchange including

- **i.** Medical orders
- **ii.** Clinical observations
- **iii.** Test results
- **iv.** Admission/transfer/discharge
- **v.** Document architecture
- **vi.** Clinical templates
- **vii.** User interface
- **viii.** EHR
- **ix.** Charge and billing information

(4) A primary example of an HL7 standard is Clinical Document Architecture (CDA)

(5) CDA is an XML-based document markup standard that specifies the structure and semantics of clinical documents for the purpose of exchange

(6) HL7 standards are widely implemented by healthcare provider organizations worldwide,

(7) Many of which have adapted the basic standards for use in their particular settings

d. ***International Health Terminology Standards Development Organisation***

(1) The International Health Terminology Standards Development Organisation (IHTSDO) is a not-for-profit association in Denmark

(2) Develops and promotes use of SNOMED-CT to support safe and effective health information exchange

(3) It was formed in 2006 with the purpose of developing and maintaining international health terminology systems

(4) SNOMED-CT is a comprehensive clinical terminology

(5) Originally created by the College of American Pathologists (CAP)

(6) As of April 2007, owned, maintained, and distributed by the IHTSDO

(7) The CAP continues to support SNOMED-CT operations under contract to the IHTSDO

(8) Provides SNOMED-related products and services as a licensee of the terminology

(9) The NLM is the US member of the IHTSDO

(10) As such, it distributes SNOMED-CT at no cost in accordance with the member rights and responsibilities outlined in the IHTSDO's Articles of Association

(11) SNOMED-CT is one of a suite of designated standards for use in US federal government systems for the electronic exchange of clinical health information

(12) SNOMED-CT is specified as a required standard for the creation and exchange of patient medical record information within the HHS Electronic Health Record Incentive Program

e. ***LOINC***

(1) Logical Observation Identifiers Names and Codes (LOINC)

(2) Is a database and universal standard for identifying medical laboratory observations

(3) It was developed and is maintained by the Regenstrief Institute in 1994

(4) The purpose of LOINC is to assist in the electronic exchange and gathering of clinical results such as

- **i.** Laboratory tests
- **ii.** Clinical observations
- **iii.** Outcomes management
- **iv.** Research

(5) Since its inception, the database has expanded to include not just medical and laboratory code names, but also:

- **i.** Nursing diagnosis
- **ii.** Nursing interventions
- **iii.** Outcomes classification
- **iv.** Patient care data set

f. ***National Council for Prescription Drug Programs***

(1) The National Council for Prescription Drug Programs (NCPDP) develops both content and transport standards for information processing in the pharmacy services sector of the healthcare industry

(2) This is a very successful example of how standards can enable significant improvements in service delivery

(3) Since the introduction of this standard in 1992, the retail pharmacy industry has moved to 100% electronic claims processing in real time

(4) NCPDP standards are forming the basis for electronic prescription transactions

(5) Electronic prescription transactions are defined as EDI messages flowing between healthcare providers (i.e., pharmacy software systems and prescriber software systems) that are concerned with prescription orders

(6) NCPDP's Telecommunication Standard Version 5.1 was named the official standard for pharmacy claims within HIPAA

- **(7)** NCPDP is also named in other US federal legislation titled the Medicare Prescription Drug, Improvement, and Modernization Act
- **(8)** Other NCPDP standards include the SCRIPT Standard for Electronic Prescribing, and the Manufacturers Rebate Standard

Discussion Point
Ask the students to compare and contrast RxNorm and the National Council for Prescription Drug Programs.

g. ***National Uniform Claim Committee recommended data set for a noninstitutional claim***

- **(1)** Organized in 1995
- **(2)** The scope of the National Uniform Claim Committee (NUCC) was to
    - **i.** Develop
    - **ii.** Promote
    - **iii.** Maintain a standard data set for use in noninstitutional claims and encounter information
- **(3)** The committee is chaired by the AMA
- **(4)** Its member organizations represent a number of the major public and private sector payers
- **(5)** The NUCC was formally named in the administrative simplification section of HIPAA as one of the organizations to be consulted by ANSI-accredited SDOs and the Secretary of HHS as they develop, adopt, or modify national standards for healthcare transactions
- **(6)** The NUCC has authoritative voice regarding national standard content and data definitions for noninstitutional healthcare claims in the United States

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. Security standards

a. ***HIPAA Security Standards for the Protection of Electronic Health Information at 45 CFR Part 160 and Part 164, Subparts A and C***

- **(1)** The HIPAA Security Rule was developed to
    - **i.** Protect electronic health information
    - **ii.** Implement reasonable and appropriate administrative safeguards that establish the foundation for a covered entity's security program
- **(2)** Prior to HIPAA, no generally accepted set of security standards or general requirements for protecting health information existed in the healthcare industry
- **(3)** Congress passed the Administrative Simplification provisions of HIPAA to
    - **i.** Protect the privacy and security of certain health information
    - **ii.** Promote efficiency in the healthcare industry through the use of standardized electronic transactions

b. ***ISO IEC 27002:2005 Standard***

- **(1)** The ISO IEC 27002:2005 Standard consists of recommended information security practices
- **(2)** It establishes guidelines and general principles for
    - **i.** Initiating
    - **ii.** Implementing
    - **iii.** Maintaining
    - **iv.** Improving information security management in an organization
- **(3)** The objectives outlined provide general guidance on the
    - **i.** Commonly accepted goals
    - **ii.** Best practices for control objectives and controls for information security management
- **(4)** Is intended as a common basis and practical guideline for
    - **i.** Developing organizational security standards
    - **ii.** Effective security management practices
    - **iii.** To help build confidence in interorganizational activities

Implementation Guides

1. Implementation guides combine one or more standards into a specific guidance set to address focused use cases or user stories
2. Using implementation guides resolves the issues and challenges of unique and inconsistent standards implementations and enables the integration of base standards in an industry-wide, uniform manner
3. In order to test and implement the standards in real-life settings, they must be specified to a higher degree of detail
4. An implementation guide becomes an explicit description of the standards, services, and policies that then conform to the adopted standards and have sufficient detail to be implemented
5. The following diagram highlights the distinction between standards and implementation guides

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Standards Coordination and Harmonization

Teaching Tip
Provide the following information, It has become clear to both public and private sector standards development efforts that no one entity has the resources to create an exhaustive set of health data standards that will meet all needs. New emphasis is being placed on leveraging and harmonizing existing standards to eliminate the redundant and siloed efforts that have contributed to a complex, difficult to navigate health data standards environment. Advances are being made in the area of standards

harmonization through the coming together of industry groups to accelerate and streamline the standards development and adoption process.

In addition to the various SDOs described above, the following organizations are working at national and international levels to create synergistic relationships between and across organizations. These emerging organizations are involved in standards development, coordination, and harmonization in all sectors of the economy. Since many of the health data standards issues, such as security, are not unique to the healthcare sector, this breadth of scope offers the potential for technology transfer and advancement across multiple sectors. The following is a brief description of some of the major national and international organizations involved in broad-based standards development, coordination, and harmonization.

1. **American National Standards Institute**
    - **a.** The American National Standards Institute (ANSI) serves as the US coordinating body for voluntary standards activity
    - **b.** Standards are submitted to ANSI by member SDOs
    - **c.** Are approved as American National Standards through a consensus methodology developed by ANSI
    - **d.** ANSI is the US representative to the International Organization of Standardization (ISO), and as such, is responsible for bringing forward US standards to that organization for approval
2. **European Technical Committee for Standardization**
    - **a.** In 1990, TC 251 on medical informatics was established by the European Committee for Standardization (CEN)
    - **b.** CEN/TC 251 works to develop a wide variety of standards in the area of healthcare data management and interchange
    - **c.** CEN standards are adopted by its member countries in Europe and are also submitted for harmonization with ISO standards
3. **Health IT Standards Committee**
    - **a.** The American Recovery and Reinvestment Act (ARRA) provided for the creation of the Health IT Standards Committee under the auspices of the Federal Advisory Committee Act (FACA)
    - **b.** The Committee is charged with making recommendations to the US National Coordinator for Health IT on
        - **(1)** Standards
        - **(2)** Implementation specifications
        - **(3)** Certification criteria for the electronic exchange and use of health information
    - **c.** In developing, harmonizing, or recognizing standards and implementation specifications, the Committee also provides for the testing of the same by the National Institute for Standards and Technology (NIST)
    - **d.** The Committee has formed several workgroups to further the work of the FACA
    - **e.** These workgroups are comprised of stakeholder representatives and subject matter experts focused on the following topic areas
        - **(1)** Clinical Operations
        - **(2)** Clinical Quality
        - **(3)** Privacy and Security
        - **(4)** Implementation
4. **Integrating the Healthcare Enterprise**

Teaching Tip
Standards, while a necessary part of the interoperability ecosystem, are not sufficient alone to fulfill the needs. Simply using a standard does not necessarily guarantee health information exchange within or among organizations and systems. Standards can be implemented in various ways, so implementation specifications or guides are critical to make interoperability a reality (Sensmeier, 2010). Standard implementation specifications are designed to provide specific configuration instructions or constraints for implementation of a particular standard or set of standards.

- **a.** Integrating the Healthcare Enterprise (IHE) is an international organization that provides a detailed framework for implementing standards, filling the gaps between standards, and their implementations
- **b.** IHE is not a standards body and does not create standards,
- **c.** It offers a common framework, available in the public domain, to understand and address critical integration needs
- **d.** IHE has published a large body of detailed specifications
    - **(1)** Called integration profiles that are being implemented globally by healthcare providers and regional entities
    - **(2)** To enable standards-based, safe, secure, and efficient health information exchange
- **e.** Vendors publish IHE integration statements to document the IHE integration profiles supported by their products that were successfully tested at an IHE Connectathon
- **f.** Users can reference the appropriate integration profiles in requests for proposals, thus simplifying the systems acquisition process
- **g.** To better differentiate those products that can deliver robust integration capabilities in production systems, IHE USA (a national deployment committee of IHE International) and ICSA Labs (an HIT testing laboratory and certification body) have implemented a testing program with formalized, rigorous, and independent examination of IHE profiles and specifications in specific versions of products going to market
- **h.** This certification testing program is based on industry best practices and international ISO standards
- **i.** Products that pass this testing and receive the IHE USA's mark of certification will operate as they should in meeting IHE functionality to achieve interoperability

5. **International Organization for Standardization**
    - **a.** The International Organization for Standardization (ISO)
        - **(1)** Develops
        - **(2)** Harmonizes
        - **(3)** Publishes standards internationally
    - **b.** ISO standards are developed, in large part, from standards brought forth
        - **(1)** By member countries
        - **(2)** And through liaison activities with other SDOs
    - **c.** Often, these standards are further broadened to reflect the greater diversity of the international community
    - **d.** In 1998, the ISO Technical Committee (TC) 215 on Health Informatics was formed to coordinate the development of international health information standards, including data standards
    - **e.** This Committee published the first international standard for nursing content titled *Integration of a Reference Terminology Model for Nursing*
    - **f.** This standard includes the development of reference terminology models for nursing diagnoses and nursing actions with relevant terminology and definitions for implementation
    - **g.** In order to address the need for global standards harmonization, the Joint Initiative Council (JIC) was founded as a liaison group under ISO/TC 215
    - **h.** Its goal is to enable common timely health informatics standards by addressing and resolving issues of gaps, overlaps, and counterproductive standardization efforts
    - **i.** Membership in JIC is restricted to international SDOs with a formal relationship to ISO and includes
        - **(1)** CEN/TC 251
        - **(2)** ISO/TC 215
        - **(3)** HL7
        - **(4)** CDISC
        - **(5)** IHTSDO
        - **(6)** GS1
        - **(7)** IHE
6. **Object Management Group**
    - **a.** The Object Management Group (OMG) is representative of a different approach to standards development
    - **b.** OMG is an international consortium of primarily for-profit vendors of information systems technology
    - **c.** Who are interested in the development of standards based on object-oriented technologies
    - **d.** While its standards are developed by private organizations, it has developed a process to lessen the potential problems noted previously with proprietary standards
    - **e.** Standards developed in OMG are required to be implemented in a commercially available product by their developers within one year of the standard being accepted
    - **f.** However, the specifications for the standard are made publicly available
    - **g.** The OMG CORBAMed working group is responsible for development of object-based standards in the health information arena
7. **Public Health Data Standards Consortium**
    - **a.** The Public Health Data Standards Consortium (PHDSC) is a national nonprofit membership-based organization of
        - **(1)** Federal, state, and local health agencies
        - **(2)** Professional associations and academia
        - **(3)** Public and private sector organizations
        - **(4)** International members
        - **(5)** Individuals
    - **b.** Its goal is to empower the healthcare and public health communities with health IT standards that improve individual and community health
    - **c.** PHDSC represents a common voice from the public health community about the national effort toward standardization of health information for healthcare and population health by
        - **(1)** Identifying priorities for new standards
        - **(2)** Promoting integration of health data systems
        - **(3)** Educating the public health community about health data standards

Teaching Tip

Provide the following information, it is increasingly recognized that combining the strengths of these efforts and their approaches tends to minimize individual weaknesses and can lead to significant gains for the healthcare sector as a whole.

As we have discussed, this melding of approaches is being achieved both at the organizational and international levels by the development of coordinating bodies and consortia, as well as through national, government-directed laws, regulations, committees, and initiatives.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Standards and Interoperability

1. **ONC Standards and Interoperability Framework**
    - **a.** The ONC Standards and Interoperability (S&I) Framework
        - **(1)** Is a collaborative community of participants from the public and private sectors
        - **(2)** Who are focused on providing the tools, services, and guidance to facilitate the functional exchange of health information
    - **b.** The S&I Framework, launched in 2011, uses a set of integrated functions, processes, and tools that enable execution of specific value-creating initiatives
    - **c.** Each S&I Initiative tackles a critical interoperability challenge through a rigorous process that typically includes
        - **(1)** Development of clinically oriented user stories and robust use cases

    - **(2)** Harmonization of interoperability specifications and implementation guidance
    - **(3)** Provision of real-world experience and implementer support through new initiatives, workgroups, and pilot projects
    - **(4)** Mechanisms for feedback and testing of implementations, often in conjunction with ONC partners such as NIST

2. Testing and certification

- **a.** The ONC has developed tools to facilitate the entire standards life cycle and maximize reuse of concepts and components, including tools and repositories for browsing, selecting, and implementing appropriate standards
- **b.** The ONC is working with NIST to provide testing tools to validate that a particular implementation conforms to a set of standards and implementation specifications
- **c.** The ONC also supports the development of an integration testing "harness" that tests how a particular component that has satisfied conformance testing requirements integrates into the reference implementation
- **d.** A certification process has been established so that organizations can be approved as certifying entities to which vendors may submit their EHR systems for review and certification
- **e.** The Health Information Technology: Initial Set of Standards, Implementation Specifications, and Certification Criteria for Electronic Health Record Technology Final Rule, published in 2010 by HHS, identifies the technical standards that must be met in the certification process, and coordinates those requirements with the meaningful use objectives

Current Initiatives

1. Health information exchange and interoperability

- **a.** Formal entities are emerging to provide both the structure and the function for health information exchange efforts at independent and governmental or regional/state levels
- **b.** These organizations, are called health information exchanges (HIEs)
- **c.** HIEs are geographically defined entities that develop and manage a set of contractual conventions and terms, and arrange for the governance and means of electronic exchange of information
- **d.** The HITECH Act authorized the establishment of the State Health Information Exchange Cooperative Agreement Program in the United States to advance appropriate and secure health information exchange across the healthcare system
    - **(1)** The purpose of this program was to continuously improve and expand these services to reach all healthcare providers in an effort to improve the quality and efficiency of healthcare
    - **(2)** Cooperative agreement recipients were funded, and many are now independently advancing the necessary governance, policies, technical services, business operations, and financing mechanisms for HIE
    - **(3)** This program was intended to advance regional and state-level HIEs, while moving toward nationwide interoperability

2. Nationwide Health Information Network and the eHealth exchange

- **a.** In 2007, ONC provided funding for the Nationwide Health Information Network (NwHIN)
- **b.** Which is a set of standards, services, and policies that enable secure health information exchange over the Internet
- **c.** The US intent for the NwHIN was to provide a foundation for the exchange of health IT across diverse entities, within communities, and across the country, to achieve the goals of the HITECH Act
- **d.** This component of the national health IT agenda has
    - **(1)** Enabled health information to follow the consumer
    - **(2)** Been available for clinical decision making
    - **(3)** Supported the appropriate use of health information beyond direct patient care so as to improve population health
- **e.** The NwHIN architecture is a specific network architecture that implements health information exchange specifications based on open standards
- **f.** In 2009, the first production exchange began between the Social Security Administration and MedVirginia, followed by the Veterans Health Administration and Kaiser Permanente
- **g.** This was the beginning of what is now known as the eHealth Exchange
- **h.** In 2012, the eHealth Exchange transitioned from operating as an ONC initiative to become a public private partnership supported by Healtheway, Inc., a nonprofit organization established to advance HIE implementation
- **i.** The eHealth Exchange has become a rapidly growing community of exchange partners, representing thousands of providers and millions of patients in support of treatment, care coordination, and public health purposes

3. Clinical integration and accountable care

- **a.** As implementation of the 2010 Affordable Care Act advances, more organizations will sign on as accountable care organizations (ACOs)
    - **(1)** Thus agreeing to provide care for a particular group of patients
    - **(2)** And to be paid on how well they do at keeping their patients healthy and lowering the costs of care
- **b.** This model of care
    - **(1)** Which is based on clinical integration
    - **(2)** Focuses on increasing quality and care coordination
    - **(3)** Requires the use of health IT to enable earlier detection of conditions, preventing them from becoming advanced chronic diseases
- **c.** Adopting standards-based information systems across the nation will enable wider sharing of patient health data and information with all members of the care team
- **d.** Legislative and regulatory reforms that are accelerating ACO and clinical integration program development among

hospitals and physician practices will support accurate and timely health information exchanged among hospital and office-based EMRS

   e. Interoperability in turn will enable the efficient coordination and continuity of care offered by the ACO

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Business Value of Health Data Standards

1. The importance of data standards to enhancing the quality and efficiency of healthcare delivery and improving health outcomes is being recognized by national and international leadership
2. Reviewing the business value of defining and using health data standards is critical for driving the implementation of these standards into applications and real-world systems
3. Having data standards for data exchange and information modeling will provide a mechanism against which deployed systems can be validated (Loshin, 2004)
4. Reducing manual intervention will increase worker productivity and streamline operations
5. Defining information exchange requirements will enhance the ability to automate interaction with external partners, which in turn will improve efficiency and decrease costs
6. A standardized nursing language is necessary so that nursing knowledge can be represented and communicated consistently among nurses and other healthcare providers
7. Identifying key data elements, defining them consistently, and capturing them in a database will build a library of evidenced-based care that can be measured and validated
8. Enhanced data collection will contribute to greater adherence to standards of care, assessment of nursing competencies, and evaluation of nursing outcomes, thus increasing the visibility of nursing interventions and improving patient care
9. By using data standards to develop their emergency department data collection system, New York State demonstrated that it is a good business practice
   a. Their project was completed on time without additional resources and generated a positive return on investment
   b. The use of standards provided the basis for consensus between the hospital industry and the state, a robust pool of information that satisfied the users, and the structure necessary to create unambiguous data requirements and specifications
10. The complex and highly fragmented healthcare system in the United States makes it difficult to develop a nationwide approach to value-based healthcare
11. According to a new report published by the Boston Consulting Group that called for better data standards and patient registries
   a. The report looked at efforts to improve health outcomes—while also maintaining or lowering costs—in the health systems of 12 countries
   b. The report outlined four key success factors:
      (1) Clinician engagement: The greatest improvement comes when clinicians are responsible not only for collecting and interpreting data, but also leading improvement efforts
      (2) National infrastructure: It looked for common standards for tracking diagnoses, treatments, outcomes, and costs at the patient level; a limited number of shared IT platforms; and a common legal framework regulating the use of patient data
      (3) High-quality data: The most effective way to collect relevant data is through disease registries to promote more effective and cost-efficient care
      (4) Outcome-based incentives: Data-driven incentive measures should spur changes in the way clinicians practice, payers reimburse, and suppliers of drugs and medical devices to develop and deliver products and services
12. Other economic stakeholders for health IT include software vendors or suppliers, software implementers who install the software to support end-user requirements, and the users who must use the software to do their work
13. The balance of interests among these stakeholders is necessary to promote standardization to achieve economic and organizational benefits
14. Defining clear business measures will help motivate the advancement and adoption of interoperable health IT systems, thus ensuring the desired outcomes can be achieved
15. Considering the value proposition for incorporating data standards into products, applications, and systems should be a part of every organization's IT strategy

SUMMARY

- This chapter introduces health data standards, the organizations that develop, coordinate, and harmonize them, the process by which they are developed, examples of current standards initiatives, and a discussion of the business value of health data standards
- Four broad areas are described to categorize health data standards
  - Transport standards are used to establish communication protocols between systems
  - Vocabulary standards are used to describe clinical problems and procedures, medications, and allergies
  - Content exchange standards and value sets are used to share clinical information such as clinical summaries, prescriptions, and structured electronic documents
  - Security standards are those used for authentication, access control, and transmission of health data
- Organizations involved in the development, harmonization, and coordination of health data standards are described
- A discussion of the standards development process highlights the international and sociopolitical context in which standards are developed and the potential impact they have on improving the health of patients and populations

- The increasingly significant role of regulation, legislation, and the federal government in furthering the development, adoption, and value of health data standards is discussed
- Several key initiatives, including
  - The ONC Standards & Interoperability Framework
  - HIEs
  - The eHealth Exchange are described, and their potential impacts are highlighted
- The influence of the emerging ACO model of care's focus on increasing quality and care coordination is explored
- Finally, the business value and importance of health data standards to improving the quality and efficiency of healthcare delivery and the role their adoption plays in improving health outcomes are emphasized

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives with the students

- Discuss the need for health data standards
- Describe the standards development process and related organizations
- Delineate the importance of health information exchange and interoperability
- Describe current health data standards initiatives
- Explore the business value of health data standard

Teaching Tip
Ask the students to define the keywords

- Standards
- Health information exchange
- Knowledge representation
- Interoperability
- Clinical integration
- Terminology

CHAPTER REVIEW QUESTIONS

Question 7.1: What best describes "What are health data standards?"

a. Used to represent a healthcare database
b. Used to describe the structure and content of healthcare information
c. Used to code nursing data
d. Used to determine hardware to describe health information

Question 7.2: What best describes the purpose of "interoperability" between HIT systems?

a. Extent to which HIT systems can manage the data processing
b. Extent to which HIT systems can exchange data and interpret the shared data
c. Extent to which HIT systems can store and process exchanged data
d. Extent to which HIT systems can utilize data for research and analysis

Question 7.3: How does Hammond describe by what methods standard are created?

a. Begins with a use case or business need to describe the system's behavior
b. It requires technical experts to analyze the proposed methods
c. A group of interested parties come together and agree upon a standard
d. A group requires the government to establish a standards agency

Question 7.4: What four broad areas categorize health data standards?

a. Content exchange, privacy, security, and safety
b. Security, safety, data, and privacy
c. Transport, vocabulary, security, and content exchange
d. Security, transport, electronic, and privacy

Question 7.5: What are some major SDOs involved in the development of transport standards (format of messages exchanged)?

a. ASC, IEE, NEMA, and W3C
b. W3C, IEEE, NEMA, and UMLS
c. NEMA, ASC, UMLS, and HL7
d. IEEE, ASC, HL7, and W3C

Question 7.6: Which use of structured terminologies is used to represent health concepts in HIT systems?

a. CPT, ICD-9, CCC, and Rx Norm
b. IEEE, CPT, CINAHL, and CCC
c. ICD-10, UMLS, RX Norm, and CINAHL
d. CCC, ICD-10, CINAHL, and UMLS

Question 7.7: Give examples of SDOs that have incorporated domain-specific data sets into their messaging standards?

a. LOINC, HL7, CINAHL, and ASTM
b. ASTM, LOINC, HL7, and CCC
c. CCC, HL7, LOINC, and CINAHL
d. ASTM, UMLS, IHTSDO, and LOINC

Question 7.8: What are the major purposes of HIPAA? Answer True or False:

a. HIPAA was passed to protect electronic health information systems. True ___ False ___
b. HIPAA was passed to protect the privacy and security of certain health information. True ___ False ___
c. HIPAA was passed to promote the efficiency on healthcare industry. True ___ False ___
d. HIPAA was passed to promote interoperability between systems. True ___ False ___
e. HIPAA was passed to implement healthcare guidelines. True ___ False ___

Question 7.9: Which data standards enhance the quality and efficiency of healthcare delivery?

a. Will decrease worker productivity

b. Will enhance the ability to automate interaction with external partners

c. Will require additional time and effort to use

d. Will require a standardized language

Question 7.10: What SDOs examples are working at national and international levels to create synergistic relationships between and across organizations?

a. CEN, IHE, HIPAA, ARRA, and CINAHL

b. ARRA, CEN ANSI, CINAHL, and HIPAA

c. ANSI, CEN, ISO, IHE, and ARRA

d. CINAHL, CEN ARRA, HIPAA, and ISO

ANSWERS AND EXPLANATIONS

Question 7.1: (b) Used to describe the structure and content of healthcare information. Data standards are intended to reduce ambiguity in communication so that the actions taken are based on data consistent with the actual meaning of the data.

Question 7.2: (b) Extent to which HIT systems can exchange data and interpret the shared data. Interoperability requires that two systems to be interoperable must be able to exchange data and subsequently the sent data can be understood by the user.

Question 7.3: (c) A group of interested parties come together and agree upon a standard. Hammond lists several methods including the one mentioned as well as by government sanctions, marketplace competition, or formal consensus process used by an SDO.

Question 7.4: (c) Transport, vocabulary, security, and content exchange. The four categories of health data standards defined by HHS are listed above. The transport standards are used to establish a common predictable, secure communication protocol between systems. The vocabulary standards consist of nomenclatures and code sets used to describe clinical problems and procedures, medications, and allergies. Content exchange standards and value sets are used to share clinical information. Security standards are used to safeguard the transmission of health data through authentication and access control.

Question 7.5: (a) ASC, IEE, NEMA, and W3C. They are the major SDOs involved in the development of transport standards.

Question 7.6: (a) CPT, ICD-9, CCC, and Rx Norm. Structured terminologies are an essential requirement for effective communication to represent concepts in an unambiguous fashion between the sender and receiver of the message.

Question 7.7: (b) ASTM, LOINC, HL7, and CCC. Content standards are related to the data content within information exchanges. Information content standards define the structure and content organization of electronic messages or document information content.

Question 7.8: T/F

a. HIPAA was passed to protect electronic health information systems True ___ X False ___

b. HIPAA was passed to protect the privacy and security of certain health information True ___ X False ___

c. HIPAA was passed to promote the efficiency on healthcare industry True ___ X False ___

d. HIPAA was passed to promote interoperability between systems True ___ False ___ X

e. HIPAA was passed to implement healthcare guidelines True ___ False ___ X

The HIPAA security rule was developed to protect electronic health information and implement reasonable and appropriate administrative safeguards that establish the foundation for a covered entity's security program.

Question 7.9: (b) Will enhance the ability to automate interaction with external partners.

Question 7.10: (c) ANSI, CEN, ISO, IHE, and ARRA. The national and international standards are working together to create a synergistic relationship between organizations. They are involved in standards development, coordination, and harmonization in all sectors of the economy.

8

Standardized Nursing Terminologies

• OBJECTIVES

1. Define "standardized nursing terminology."
2. Describe the impact of terminologies on nursing.
3. Describe the features of advanced nursing terminology systems.

• KEY WORDS

Advanced nursing terminology
Concepts
Concept-oriented
Classification
Data
Data element
Nursing terminology
Vocabulary

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give an example of a vocabulary? Why is the vocabulary important? What are the characteristics of the vocabulary? Is a vocabulary different from a terminology? Why are terminologies and vocabularies important in healthcare? Can you give examples?

For a WIIFM statement, say to the class: "This chapter focuses on providing the background necessary to understand standardized nursing terminologies, standardized nursing concepts and data elements, and their impact on nursing practice. The chapter provides an overview of the characteristics of nursing terminologies and how they are used in today's HIT and EHR systems. It further provides an overview of advanced nursing terminologies and describes how they can contribute to today's informatics infrastructure." As a nurse, it is important to understand vocabularies, terminologies, and ontologies used in healthcare.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook.
2. Review terminology, vocabulary, and standards development organizations (SDOs).
3. Encourage students to visit Internet Web sites related to the chapter topic.

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Teaching Tip

Use the following to introduce the students to the chapter. In the present technological environment, the need for nursing to become visible through the documentation of nursing practice in emerging Healthcare Information Technology (HIT) and Electronic Health Record (EHR) Systems is critical. Nursing can no longer rely on the intuition of senior nurses, or on the

(*continued*)

trial-and-error of tradition-oriented nursing practice but rather the profession needs to conduct research and generate measures and evidence to prove that their nursing care improves quality, safety, and healthcare outcomes. To become visible nursing needs to electronically document nursing practice using a standardized nursing terminology with coded concepts in order to measure the effectiveness of their care delivery and thus generate the evidence.

A standardized nursing terminology consists of nursing concepts that represent the domain of nursing. A nursing terminology must include standardized nursing data that represent the essential building blocks for nursing practice. Such nursing data are critical to the development of data sets that can be used for analysis and integrated with the data of other healthcare disciplines. The standardized nursing data sets might also serve as research data to advance the science of nursing practice.

The U.S. Institute of Medicine in a 2012 report recommended that the capture of clinical care data is needed for better patient care coordination and management. It stated that our patient care data is poorly captured and managed, and our evidence poorly used. The report focused on the need recommended by the U.S. National Coordinator for Healthcare Information Technology (ONC) to improve interoperability across systems to support better care. The report also recommended that to be usable the standardized data must be captured in real-time and at the point-of-care.

Standardized nursing terminologies are needed to (a) provide valid clinical care data, (b) allow data sharing across today's HIT and EHR systems, (c) support evidence-based decision making, (d) facilitate evaluation of nursing processes, and (e) permit the measurement of outcomes. Standardized concepts and data elements are also needed to facilitate **aggregation** and **comparison** for clinical, translational, and comparative effectiveness research, as well as for the development of practice-based nursing protocols and evidence-based knowledge, including the generation of healthcare policy. Lastly, to support continuity of care and the exchange of data, for example to implement in the United States the federal regulations for "meaningful use" (MU), the standardized nursing concepts must be **interoperable** between HIT and EHR systems, across healthcare settings and population groups. Such demands require that the initial standardized nursing terminology concepts be coded in a structure that is suitable for computer-based processing.

This chapter focuses on providing the background necessary to understand standardized nursing terminologies, standardized nursing concepts and data elements, and their impact on nursing practice. The chapter provides an overview of the characteristics of nursing terminologies and how they are used in today's HIT and EHR systems. It further provides an overview of advanced nursing terminologies and describes how they can contribute to today's informatics infrastructure. Note that the word "terminology" is used throughout the chapter to refer also to "classification," "vocabulary," "taxonomy," or "nomenclature." Concepts and terms that are coded for computer processing are referred to as "data" or "data elements."

Background

1. Historical events
   - **a.** Terminological work within the nursing professions has been ongoing for many years
   - **b.** As early as 1859, Florence Nightingale named her six canons of care as "what nurses do" in her text *Notes on Nursing*
     - **(1)** She considered the six canons to be measures of "good standards" essential for the practice of nursing
   - **c.** It took another 80 years for her work to be expanded in the United States when Virginia Henderson published her *Textbook of the Principles and Practices of Nursing* in which she delineated her "14 patterns of daily living"
   - **d.** Her works were followed by the works of several nurse-theorists who presented their theories and standards of nursing practice such as
     - **(1)** Peplau's "Four Major Life Tasks"
     - **(2)** Orem's "Universal Self-Care Deficits"
     - **(3)** King's "Process of Nursing"
     - **(4)** Roger's "Four Building Blocks"
     - **(5)** Abdellah's "21 Problems"
   - **e.** These models were all developed as approaches to patient care; however, none referred to or predicted the use of computers to support the implementation of nursing practice standards
   - **f.** In 1970 the American Nurses Association (ANA) approved the **nursing process** as the standard of professional nursing practice
   - **g.** Yura and Walsh identified the nursing process as representing an orderly, systematic orientation to addressing a client's condition
     - **(1)** They described the nursing process as providing the framework for gathering patient care data
     - **(2)** Beginning with the assessment phase which also identified the client's conditions, which they referred to as nursing diagnoses, through goal designations and the planning of nursing activities, and ending with evaluation
     - **(3)** Also identified their "34 Human Needs Assessment" which they outlined with the "Proposed Nursing Diagnoses"
2. Health terminologies
   - **a.** During this same time period in the United States computer technology was being introduced in hospitals, albeit primarily for administrative applications
   - **b.** It was relatively easy for vendors to computerize hospital billing applications since hospitals were already using an established terminology for payment for disease conditions and/or services
   - **c.** The International Classification of Diseases (ICD)
     - **(1)** Was being used internationally for the reporting of mortality and morbidity statistics
     - **(2)** Was also being used by the U.S. federal government for payment of healthcare services
   - **d.** Other hospital specialty departments initiated different terminologies for payment of their specific services such as
     - **(1)** *Physician's Current Procedural Terminology* (CPT) for surgical procedures
     - **(2)** *Logical Observation Identifiers Names and Codes* (LOINC) for laboratory tests

- **e.** During this period, however, nursing did not have any recognized terminologies to
  - **(1)** Characterize their patients
  - **(2)** Describe nursing interventions
  - **(3)** Support documentation
- **f.** Subsequent nursing terminology development was motivated by a number of factors
  - **(1)** The need to quantify nursing resources
  - **(2)** The introduction of the electronic health record in healthcare facilities
  - **(3)** The development of knowledge bases and growth of evidence-based nursing practice

3. Nursing and computers
- **a.** In 1985, the American Nurses Association (ANA) initiated the Council on Computer Applications in Nursing (CCAN) which promoted the nursing profession to become involved in the integration of computer-based applications in nursing practice, education, and research
- **b.** The CCAN Executive Board was responsible for numerous initiatives and served as a moving force for this new nursing specialty
- **c.** The CCAN supported the conduct of several conferences on computers in nursing practice
- **d.** This activity was mirrored in a number of countries worldwide
- **e.** It was during this time that Graves and Corcoran adapted Blum's concepts of data (discrete entities), information (interpreted data), and knowledge (formalized information) as a framework for understanding the impact of computer-based systems on healthcare
  - **(1)** They also supported the need for computer-based nursing terminologies by their definition of Nursing Informatics: Nursing Informatics combines nursing science, information science, and computer science to manage and process nursing data, information, and knowledge to facilitate the delivery of healthcare
- **f.** In 1992, the CCAN name was changed to the Database Steering Committee and continued their involvement by approving Nursing Informatics as a new nursing specialty
- **g.** Also during that year the Council
  - **(1)** Developed the criteria for a nursing terminology
  - **(2)** As well as "recognizing" the first nursing terminologies as appropriate for the documentation of nursing practice including
    - i. NANDA's Classification of Nursing Diagnoses
    - ii. Home Health Care Classification (HHCC) [(now Clinical Care Classification (CCC) System]
    - iii. Nursing Intervention Classification (NIC)
    - iv. The Omaha System
- **h.** The remaining "recognized" terminologies that exist today are
  - **(1)** Nursing Outcome Classification (NOC)
  - **(2)** Perioperative Nursing Data Set (PNDS)
  - **(3)** International Classification for Nursing Practice (ICNP)
  - **(4)** ABC Codes
  - **(5)** Logical Observation Identifiers Names and Codes (LOINC)
  - **(6)** Systematic Nomenclature of Medicine—Clinical Terms (SNOMED CT)
- **i.** Two data sets are also recognized:
  - **(1)** The Nursing Minimum Data Set (NMDS)
  - **(2)** The Nursing Management Minimum Data Set (NMMDS)
- **j.** The majority of these terminologies are considered to be
  - **(1)** "Interface terminologies"
  - **(2)** "User terminologies"
  - **(3)** "Point-of-care" terminologies
- **k.** ICNP and SNOMED CT also have reference properties
- **l.** A reference terminology acts as a common reference point that can, for example, facilitate cross-mapping between interface terminologies
- **m.** Several nursing terminologies have been integrated into the Metathesaurus of the Unified Medical Language System (UMLS), developed by the U.S. National Library of Medicine (NLM)
  - **(1)** The Metathesaurus in the UMLS is a large, multipurpose, and multilingual thesaurus that contains millions of biomedical and health-related concepts, their synonymous names, and their relationships
- **n.** Nursing terminologies vary in scope, structure, and content
- **o.** They were
  - **(1)** Developed by different organizations
  - **(2)** With different funding sources
  - **(3)** For different purposes
  - **(4)** With different foci
  - **(5)** With different copyright privileges
- **p.** Most of the early terminologies were initially developed for paper-based documentation of nursing care
  - **(1)** The CCC System was designed specifically for computer-based documentation and processing
- **q.** Over time and with the advancement of technology, all of the nursing terminologies have now been adapted for computer processing

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. Coding structure and terminology
- **a.** A standardized nursing terminology with nursing concepts and data requires a tree structure that allows for the data to be
  - **(1)** Aggregated upward
  - **(2)** Parsed downward to the atomic-level data elements

- **b.** The coded data might also be organized using a nursing terminology framework to document and link the nursing process phases together:
    - **(1)** Assessment
    - **(2)** Diagnosis
    - **(3)** Expected outcome
    - **(4)** Planning
    - **(5)** Implementation
    - **(6)** Evaluation of the actual outcomes
- **c.** The framework should allow for the
    - **(1)** Collection of data to be in real-time at the point-of-care
    - **(2)** With ongoing processing that allows for feedback loops (reuse of the data concepts) based on the patient's responses to their interventions/actions (care)
    - **(3)** Then be able to generate outcomes for comparison

5. Nursing terminology challenges

- **a.** Currently, there is a movement to harmonize nursing and multidisciplinary terminologies
- **b.** However, there are two major challenges:
    - **(1)** First, the existence of multiple, specialized terminologies has resulted in areas of overlapping content, areas for which there was no content, and large numbers of different codes and terms
    - **(2)** Second, existing terminologies most often were developed to provide sets of terms and definitions of concepts for human interpretation, with computer interpretation only as a secondary goal
- **c.** The latter is particularly true for nursing terminologies that have been designed primarily for direct use by nurses in the course of clinical care (Association of Operating Room Nurses [AORN])
- **d.** It is unfortunate that knowledge eminently understandable by nurses is often
    - **(1)** Confusing
    - **(2)** Ambiguous
    - **(3)** Opaque to computers
- **e.** Consequently, previous efforts often resulted in terminologies that in some ways were inadequate in meeting the data needs of nursing practice in today's HIT and EHR systems

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Advanced Terminology Systems in Nursing

1. Nursing requirements

- **a.** The HIT and EHR systems that support functionality such as decision support may require more granular (i.e., less abstract) data than may be found in today's interface terminologies
- **b.** More advanced terminology systems are needed that allow for much greater granularity through controlled composition while avoiding a combinatorial explosion of pre-coordinated terms

2. Formal terminologies

- **a.** Advanced terminology systems such as ICNP and SNOMED CT are a focus of today's harmonizing efforts
- **b.** Both terminologies facilitate two important facets of knowledge representation for HIT and EHR systems that support clinical care
    - **(1)** **Describing concepts**
    - **(2)** **Manipulating and reasoning** about those concepts using computer-based tools
- **c.** Advantages resulting from the first facet—describing concepts—include
    - **(1)** Non-ambiguous representation of concepts
    - **(2)** Facilitation of data abstraction or de-abstraction without loss of original meaning (i.e., "loss-less" data transformation)
    - **(3)** Non-ambiguous mapping among terminologies
    - **(4)** Data reuse in different contexts
    - **(5)** Data interoperability across settings
- **d.** These advantages are particularly important for clinical uses of the terminology
- **e.** Advantages gained from the second facet—manipulating and reasoning—include
    - **(1)** Auditing the terminology system
    - **(2)** Automated classification of new concepts
    - **(3)** An ability to support multiple inheritance of defining characteristics (e.g., "acute postoperative pain" is both a "pain" and a "postoperative symptom")
- **f.** Both facets are vital to
    - **(1)** The maintenance of the terminology itself

As well as to the ability to subsequently support the clinical utility of the terminology (Campbell, Cohn, Chute, Shortliffe, & Rennels, 1998; Rector et al., 1997)

3. Characteristics of advanced terminologies

- **a.** Healthcare terminologies suitable for implementation in HIT systems have been studied by numerous experts who have provided an evolving framework that enumerates the recommended criteria
- **b.** The characteristics apply to any terminology being used in the healthcare industry as well as for a nursing terminology
- **c.** It is clear that such terminologies
    - **(1)** Must be concept-oriented (with explicit semantics)
    - **(2)** Rather than based on surface linguistics
- **d.** Other recommended criteria for terminologies include
    - **(1)** Domain completeness
    - **(2)** A polyhierarchical organization
- **e.** Additional criteria applying to concepts themselves include being
    - **(1)** Atomic-level (single concept coded as a single data element)

        (2) Non-redundancy (unique identifier)
        (3) Non-ambiguity (explicit definition)
        (4) Concept permanence (cannot be duplicated)
        (5) Compositionality (ability to combine concepts to form new unique concepts)
        (6) Synonymy (a single concept supports multiple terms or synonyms)

4. Concept orientation

- **a.** In order to appreciate the significance of concept-oriented approaches, it is important to
    - **(1)** First understand the definitions of and relationships among things in the world (objects)
    - **(2)** Our thoughts about things in the world (concepts)
    - **(3)** The labels we use to represent and communicate our thoughts about things in the world (terms)
    - **(4)** The coded data elements needed to represent and be processed by computer
- **b.** The terminology relationships are depicted by a descriptive model commonly called the semiotic triangle

Teaching Tip
Refer to Figure 8.1.

- **c.** The International Organization for Standardization (ISO) International Standard ISO 1087-1:2000 provides definitions for elements that correspond to each vertex of the triangle
    - **(1)** **Concept** (i.e., thought or reference): Unit of knowledge created by a unique combination of characteristics—a characteristic is an abstraction of a property of an object or of a set of objects
    - **(2)** **Object** (i.e., referent): Anything perceivable or conceivable
    - **(3)** **Term** (i.e., symbol): Verbal designation of a general concept in a specific subject field—a general concept corresponds to two or more objects which form a group by reason of common properties
- **d.** A single concept may be associated with multiple terms (synonym)

5. Model structures

- **a.** A terminology model is a concept-based representation of a collection of domain-specific terms (data elements) that is optimized for the management of terminological definitions
- **b.** It encompasses both “schemata” and “type definitions”
- **c.** Schemata incorporate domain-specific knowledge about
    - **(1)** The typical constellations of entities
    - **(2)** Attributes
    - **(3)** Events in the real world

Teaching Tip
Provide the following as an example. Reflect plausible combinations of concepts for naming a nursing diagnosis or problem, e.g., “pain” may be combined with “acute” or “chronic” to make “acute pain” or “chronic pain” or for naming clinical nursing intervention, e.g., “vital signs” may be combined with “teach” to form “teach vital signs.”

- **d.** Schemata may be supported by either formal or informal composition rules (i.e., grammar)
- **e.** Type definitions address obligatory conditions that state only the essential properties of a concept, e.g., a nursing activity must have a *recipient*, an *action*, and a *target*
- **f.** Examples of terminology models that can be used to guide or underpin nursing terminologies are embedded within the international technical standard ISO 18104:2003 *Integration of a Reference Terminology Model for Nursing*

6. Reference terminology models for nursing

- **a.** In 2003, the ISO which is responsible for identifying international standards for Health Informatics passed ISO 18104:2003 *Integration of a Reference Terminology Model for Nursing* which covers two Reference Terminology Models
    - **(1)** One for Nursing Diagnoses
    - **(2)** One for Nursing Actions

Teaching Tip
Refer to Figure 8.4.

- **b.** The standard was developed by a group of experts within ISO Technical Committee 215 (Health Informatics) Working Group 3 (Semantic Content), including representatives of
    - **(1)** The International Medical Informatics Association–Nursing Informatics Working Group (IMIA-NI)
    - **(2)** The International Council of Nurses (ICN)
- **c.** The model built on work originating within the European Committee for Standardization (CEN)

7. Development of ISO 18104:2003

- **a.** The development of ISO 18104:2003 was motivated in part by a desire to harmonize the plethora of nursing terminologies in use around the world
- **b.** Another major incentive was to integrate with other evolving terminology and information model standards
- **c.** The development of ISO 18104:2003 was intended to be “consistent with the goals and objectives of other specific health terminology models in order to provide a more unified reference health model”
- **d.** Potential uses identified for the terminology models included to
    - **(1)** Facilitate the representation of nursing diagnosis and nursing action concepts and their relationships in a manner suitable for computer processing
    - **(2)** Provide a framework for the generation of compositional expressions from atomic concepts within a reference terminology
    - **(3)** Facilitate the mapping among nursing diagnosis and nursing action concepts from various terminologies

  - **(4)** Enable the systematic evaluation of terminologies and associated terminology models for purposes of harmonization
  - **(5)** Provide a language to describe the structure of nursing diagnosis and nursing action concepts in order to enable appropriate integration with information models
- **e.** The standard is not intended to be of direct benefit to practicing nurses
- **f.** It is intended to be of use to those who develop
  - **(1)** Coding systems
  - **(2)** Terminologies
  - **(3)** Terminology models for other domains
  - **(4)** Health information models
  - **(5)** Information systems
  - **(6)** Software for natural language processing
  - **(7)** Markup standards for representation of healthcare documents
- **g.** The ISO 18104:2003 models have undergone substantial bench testing
  - **(1)** During their development
  - **(2)** Through independent research
- **h.** The standard was under revision at the time of writing

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

8. Ontologies
- **a.** Terminology models may be formulated and elucidated in an ontology language which represents
  - **(1)** Classes (also referred to as concepts, categories, or types)
  - **(2)** Their properties (also referred to as relations, slots, roles, or attributes) such as Web Ontology Language (OWL)
- **b.** Ontology languages or terminologies are able to support, through explicit semantics, the formal definition of concepts in terms of their relationships with other concepts
- **c.** They also facilitate reasoning about those concepts

Teaching Tip
Provide the example. Whether two concepts are equivalent or whether one concept, such as "vital sign" subsumes (is a generalization of) another, such as "temperature, pulse, and respirations (TPR)."

- **d.** Ontology languages are often used to support advanced terminologies

Teaching Tip
Provide the example of the use of OWL to represent ICNP.

9. OWL representation of ICNP
- **a.** Outside the health domain, work in relation to the Semantic Web has resulted in the recognition of OWL as an emerging standard (i.e., a W3C recommendation)
- **b.** OWL is intended for use where applications, rather than humans, process information
- **c.** As such, it should be able to meet the requirements of advanced terminology systems that support contemporary healthcare
- **d.** OWL builds on existing recommendations such as
  - **(1)** Extensible Markup Language (XML) (surface syntax for structured documents)
  - **(2)** Resource Description Framework (RDF) (a data model for resources)
  - **(3)** RDF Schema (a vocabulary for describing the properties and classes of resources)
- **e.** Provides additional vocabulary and a formal semantics
- **f.** Software, both proprietary and open source, is available for
  - **(1)** Managing terminology models or ontologies developed in OWL (e.g., Protégé)
  - **(2)** Reasoning on the model (e.g., FaCT++)
- **g.** Work within nursing is now well-established

Teaching Tip
Provide the example. ICNP is maintained in OWL—it is a compositional standards-based terminology for nursing practice.

- **h.** The compositionality of ICNP further facilitates the development of and the cross-mapping among local terminologies and existing classification systems

Teaching Tip
Provide the example. An OWL representation (in XML) of the nursing activity concept "Bladder Irrigation" is provided in Table 8.4.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

10. ICNP as a terminology
- **a.** The ICNP is a major product of the International Council of Nurses (ICN), Geneva, Switzerland
- **b.** It is a formal terminology for nursing practice and is used to represent
  - **(1)** Nursing diagnosis
  - **(2)** Outcomes
  - **(3)** Intervention
- **c.** The primary motivation for an international nursing terminology involves sharing and comparing nursing data across
  - **(1)** Settings
  - **(2)** Countries
  - **(3)** Languages

- **d.** These data can be used to
  - **(1)** Support clinical decision making
  - **(2)** Evaluate nursing care and patient outcomes
  - **(3)** Develop health policy
  - **(4)** Generate knowledge through research
- **e.** Using a formal ontological approach, ICNP can complement existing terminologies, such as the CCC System and SNOMED CT
- **f.** The CCC has been demonstrated to support the electronic capture of discrete patient care data for documenting and coding the "essence of care" and measuring the relationship of nursing care to patient outcomes
- **g.** The CCC, an "interface terminology," is being mapped to ICNP, which will benefit both terminologies and their users

Teaching Tip

Provide the example by enabling ICNP users to code their terminologies using the CCC or to allow the comparison of CCC data with data recorded using other terminologies.

11. SNOMED CT
- **a.** SNOMED Clinical Terms (CT) is another advanced terminology system being used within a wider healthcare context (including within nursing)
- **b.** SNOMED CT which was developed collaboratively by the College of American Pathologists and the UK National Health Service now falls under the responsibility of the International Health Terminology Standards Development Organization (IHTSDO)
- **c.** In common with ICNP, SNOMED CT possesses both reference properties and user interface terms.
- **d.** SNOMED CT is considered to be the most comprehensive, multilingual clinical healthcare terminology in the world
- **e.** Integrates, through external mappings, concepts from many nursing terminologies
- **f.** In the United States, SNOMED CT is distributed at no cost by the NLM
- **g.** Licensees of the UMLS Metathesaurus are granted free access to SNOMED CT
- **h.** SNOMED CT is one of a suite of designated standards for use for the electronic exchange of health information and also is a required standard in interoperability specifications of the U.S. Health Information Technology Standards Panel (HITSP)
- **i.** A harmonization agreement exists between IHTSDO and ICN
- **j.** Joint work between IHTSDO and ICN has resulted in a table of equivalents for concepts within SNOMED CT and ICNP
- **k.** These equivalencies are important as they mean that those who choose to use ICNP are able to play a full part in any broader health informatics infrastructure

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Nursing Minimum Data Set (NMDS)

Teaching Tip

Provide the following information. Terminologies obviously rely on structures and processes that guide the collection of data. A Nursing Minimum Data Set (NMDS) identifies essential, common, and core data elements to be collected for all patients/clients receiving nursing care. A NMDS generally includes three broad categories of elements: (a) nursing care, (b) patient or client demographics, and (c) service elements (see Table 8.5). Many of the NMDS elements are consistently collected in the majority of patient/client records across healthcare settings in especially the patient and service elements. The aim of the NMDS is not to be redundant with respect to other data sets, but rather to identify what are the minimal data needed to be collected from records of patients receiving nursing care.

1. Nursing Minimum Management Data Set
- **a.** NMDSs such as the U.S. NMDS often address "intensity"
- **b.** No current NMDS addresses the essential breadth of contextual variables
- **c.** The development within the United States of the NMMDS addresses this void
- **d.** The 18 NMMDS elements are organized into 3 categories:
  - **(1)** Environment
  - **(2)** Nursing care resources
  - **(3)** Financial resources
- **e.** The NMMDS is the minimum set of items of information with uniform definitions and categories concerning the specific dimension of the context of patient/client care delivery
- **f.** It represents the essential data used to support the management and administration of nursing care delivery across all types of settings
- **g.** The NMMDS most appropriately focuses on the nursing delivery unit/service/center of excellence level across these settings
- **h.** The NMMDS supports numerous constructed variables as well as aggregation of data, e.g., unit level, institution, network, system
- **i.** This NMMDS provides the structure for the collection of uniform information that influences quality of patient care, directly and indirectly
- **j.** These data, in combination with actual patient data identified in the NMDS, support
  - **(1)** Clinical decision making
  - **(2)** Management decisions regarding the quantity, quality, and satisfaction of personnel
  - **(3)** Costs of patient care

        - **(4)** Clinical outcomes
        - **(5)** Internal and external benchmarking
    - **k.** The Environment and Nursing Care categories for the NMMDS have been
        - **(1)** Reviewed
        - **(2)** Normalized to national data definition standards
        - **(3)** Incorporated into LOINC (Regenstrief Institute, 2014)
    - **l.** Most elements of the NMMDS are available
        - **(1)** Through implementation of the LOINC standard
        - **(2)** Making collection of these contextual variables
        - **(3)** Inclusion in outcomes analysis more efficient
- **2.** International Nursing Minimum Data Set
    - **a.** The International Nursing Minimum Data Set (i-NMDS) project is intended to build on and support data set work already underway in individual countries
    - **b.** Data collected in the i-NMDS pilot project will be cross-mapped and normalized to ICNP
    - **c.** This i-NMDS work will assist in testing the utility of i-NMDS and also advancing the ICNP as a unifying framework
    - **d.** The i-NMDS project focuses on coordinating ongoing national-level efforts
    - **e.** The i-NMDS includes the
        - **(1)** Core
        - **(2)** Internationally relevant
        - **(3)** Essential
        - **(4)** Minimum data elements to be collected in the course of providing nursing care
    - **f.** These data can provide information to
        - **(1)** Describe
        - **(2)** Compare
        - **(3)** Examine nursing practice around the globe
    - **g.** Work toward the i-NMDS is intended to build on the efforts already underway in individual countries

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY AND IMPLICATIONS FOR NURSING

- The majority of nursing terminologies that exist today were developed originally many years ago and were primarily designed for the manual documentation of nursing practice
- However, with the heavy emphasis on automation, the emergence of HIT and EHR systems, and the entrance of the federal government mandating technological regulations, the configuration of hospitals' HIT and EHR systems have changed to a more business model
- For example in the United States with the passage of the HITECH ACT of 2009, and the implementation of "MU" Stages regulating technological processing of all patient services for federal payment, the documentation of patient care and the development of nursing plans of care have become secondary to the revenue generating departments' processing of their services
- The developers of nursing and healthcare terminologies and informatics scientists have made significant progress
- From decades of nursing language research, there exists an extensive set of terms
    - Describing patient problems
    - Nursing interventions and actions
    - Nursing-sensitive patient outcomes
    - Robust information models, such as the NMDS, to guide the collection of those terms
- Through the efforts of nursing professionals, new terms which are useful for representing nursing-relevant concepts have been integrated into or linked into large healthcare terminologies
- A number of efforts within nursing (e.g., ICNP) and the larger healthcare arena (e.g., SNOMED CT) are aimed toward the achievement of advanced terminology systems that support semantic interoperability across healthcare information systems; collaborative working is facilitating this process
- Ontology languages supported by suites of software tools have been developed within the context of terminologies with broad coverage of the healthcare domain
- Applicability of these tools to the nursing domain has been demonstrated
- A major ongoing challenge is the development of granular nursing content
- However, existing standardized nursing terminologies continue to be an excellent source
- Today, advanced concept-oriented terminology systems are emerging as essential infrastructure for clinical practice
- They now:
    - Provide for nonambiguous concept definitions
    - Facilitate composition of complex concepts from more primitive concepts
    - Support mapping among terminologies
- A number of benefits are being realized through the use of advanced terminology systems such as
    - The facilitation of evidence-based practice (e.g., linking of clinical practice guidelines to appropriate patients during the patient-provider encounter)
    - The matching of potential research subjects to research protocols for which they are potentially eligible
    - The detection of and prevention of potential adverse outcomes
    - The linking of online information resources
    - The increased reliability and validity of data for quality evaluation
    - The data mining of concepts for purposes such as clinical research, health services research, or knowledge discovery

- In addition, other research is focusing on examining how terminology models and advanced terminology systems relate to other types of models that support semantic interoperability, such as
    - The Health Level 7 Reference Information Model (RIM)
    - The open EHR Archetypes
    - The Detailed Clinical Models
    - The ontology for document naming
- Such interoperability is a prerequisite to meeting the information demands of today's complex healthcare, management, and nursing environments

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Define "standardized nursing terminology"
- Describe the impact of terminologies on nursing
- Describe the features of advanced nursing terminology systems

Teaching Tip
Ask the students to define the keywords

- Advanced nursing terminology
- Concepts
- Concept-oriented
- Classification
- Data
- Data element
- Nursing terminology
- Vocabulary

CHAPTER REVIEW QUESTIONS

Question 8.1: What best describes "What is a standardized nursing terminology"?

a. A standardized nursing terminology is needed to provide family history and demographic data True ___ False ___

b. A standardized nursing terminology allows the development and design of HIT and EHR architecture True ___ False ___

c. A standardized nursing terminology supports evidenced-based decision making True ___ False ___

d. A standardized nursing terminology permits the measurements of outcomes True ___ False ___

e. A standardized nursing terminology facilitates the documentation and evaluation of physician operations and procedures True ___ False ___

Question 8.2: What was the official name of the first American Nurses Association Council related to Computers in Nursing?

a. Database Steering Committee

b. Council on Computer Applications in Nursing

c. Council on Nursing and Computers

d. Council on Healthcare Computers in Nursing

Question 8.3: What are the first four nursing terminologies "recognized" by the ANA in 1992?

a. NANDA, SNOMED, NIC, and Omaha

b. CCC, Omaha, NANDA, and NIC

c. NIC, NOC, NANDA, and Omaha

d. SNOMED, LOINC, NANDA, and NOC

Question 8.4: Which are the differences between "Interface Terminology" and "Reference Terminology?"

a. An Interface Terminology uses medical terms that physicians use, whereas a Reference Terminology acts as a common reference point that can cross-map between Interface Terminologies

b. An Interface Terminology uses common terms that nurses use, whereas a Reference Terminology acts as a unique reference that cannot cross-map between Interface Terminologies

c. An Interface Terminology uses common terms that nurses use, whereas a Reference Terminology acts as a common reference point that can cross-map between Interface Terminologies

d. An Interface Terminology uses common terms that nurses use, whereas a Reference Terminology acts as a mapping standard between Interface Terminologies

Question 8.5: What best characterizes Advanced Terminology Systems used for nursing?

a. They must be concept-oriented

b. They must be a database

c. They must represent hardware architecture

d. They must be fully automated

Question 8.6: Which selected features represent advanced terminology concepts as recommended by Cimino?

a. Atomic-level, an Explicit Definition, and organized in a Relational Database.

b. Non-redundancy, Atomic -Level, and coded in SNOMED

c. Non-ambiguity, Compositionality, and coded as CINAHL

d. Concept Permanence, Atomic-level and Uniquely identified

Question 8.7: Which best describes the ISO *Integration of a Reference Terminology Model for Nursing*?

- **a.** Is a Model that defines one nursing terminology: Reference Terminology Model for Nursing Diagnoses and/or Interventions
- **b.** Is a Model that defines two nursing terminologies: Reference Terminology Model for Nursing Diagnoses and Reference Terminology Model for Nursing for Nursing Actions
- **c.** Is a Model that defines three terminologies: Reference Terminology Model for Nursing Diagnoses, Reference Terminology for Nursing Actions, and Reference Terminology Model for Clinical Care Documentation
- **d.** Is a Model that defines nursing acuity/Patient Classification System of Acuity

Question 8.8: Check if statements about nursing languages are True or False.

- **a.** ICNP is a product of the American Nurses Association. True ___ False ___
- **b.** CCC is being harmonized with ICNP. True ___ False ___
- **c.** SNOMED CT was developed in the United States. True ___ False ___
- **d.** IHTSDO is being harmonized with HL7 True ___ False ___
- **e.** CCC is integrated in the Metathesaurus of the UMLS True ___ False ___

Question 8.9: Which statement best describes SNOMED CT?

- **a.** SNOMED CT consists of only pathology terms
- **b.** SNOMED CT consists of only nursing concepts
- **c.** SNOMED CT is an Advanced Terminology System
- **d.** SNOMED CT was developed by the American Nurses Association

Question 8.10: What are the four data elements in the NMDS?

- **a.** Intensity of Nursing Care, Staffing, Payer Type, and Nursing Diagnosis
- **b.** Payer Type, Nursing Outcomes, Volume, and Nursing Interventions
- **c.** Nursing Interventions, Payer Type, Facility ID, and Intensity of Nursing Care
- **d.** Nursing Diagnosis, Intensity of Nursing Care, Nursing Outcome, and Nursing Intervention

ANSWERS AND EXPLANATIONS

Question 8.1:

- **a.** False
- **b.** False
- **c.** True
- **d.** True
- **e.** False

A standardized nursing terminology is needed to provide valid clinical care data, allow data sharing across today's HIT and EHR systems, support evidenced-based decision making, facilitate evaluation of nursing processes, and permit the measurement of outcomes. Standardized concepts and data elements are also needed to facilitate aggregation and comparison for clinical, translational, and comparative effective research. Also to accomplish these requirements the nursing terminology concepts should be coded in a structure that is suitable for computer-based processing.

Question 8.2: (b) Council on Computer Applications in Nursing. The Council on Computer Applications in Nursing (CCAIN) was introduced by Harriet Werley and colleagues to the ANA Congress on Nursing Practice in 1985 and approved. Once accepted the first Executive Board was established with the following nursing informatics pioneers: Harriet Werley, Chair; Virginia Saba, Kathleen McCormick, Rita Zielstorff, and Ivo Abraham.

Question 8.3: (b) CCC, Omaha, NANDA, and NIC. The first four nursing terminologies that existed were all recognized by the ANA Database Steering Committee Chaired by Norma Lang in the Fall of 1991 and Approved by the Congress on Nursing Practice in Spring 1992.

Question 8.4: (c) An Interface Terminology uses common terms that nurses use, whereas a Reference Terminology acts as a common reference point that can cross-map between Interface Terminologies.

Question 8.5: (a) They must be concept-oriented. Advanced Terminology Systems such as ICNP and SNOMED CT—both terminologies facilitate two important facets of knowledge representation for HIT and HER systems that support clinical care by (a) describing concepts and (b) manipulating and reasoning about those concepts using computer-based tools.

Question 8.6: (a) Atomic-level, an Explicit Definition, and Organized in a Relational Database. Cimino in his 1998 article called the "Desiradata" (Desired data) identified nine features or criteria that every healthcare terminology required. They have been used by healthcare standards as the guideline for evaluation.

Question 8.7: (b) Is a Model that defines two nursing terminologies: Reference Terminology Model for Nursing Diagnoses and Reference Terminology Model for Nursing for Nursing Actions. The Reference Terminology Model for Nursing consisted of two models: one for Nursing Problems or Diagnoses and one for Nursing Actions or Interventions. They were submitted and approved by ISO Technical Committee 215 (Health Informatics) Working Group 3 (Semantic Content). The model was developed by a group of NI experts from the AMIA-NI SIG, and ICN. It has been implemented in Europe.

Question 8.8:

- **a.** False
- **b.** True
- **c.** True
- **d.** False
- **e.** True

The nursing languages listed include not only six interface terminologies/classifications: CCC, Omaha, NANDA, NIC, NOC, and

AONE, but also the two reference or advanced terminologies: ICNP, and SNOMED CT. The CCC has been mapped to SNOMED CT and to ICNP. Since SNOMED CT is required by HHS for the HITECH Act of 2009 and for the implementation of Meaningful Use, the mapping of the nursing interface terminologies to SNOMED CT is essential.

Question 8.9: (c) SNOMED CT is an Advanced Terminology System. SNOMED CT was developed by the College of American Pathologists and integrated into the Metathesaurus of the UMLS by the NLM. SNOMED CT, once acquired by NLM, was mandated by HHS to distribute its database without charge so that the U.S. Healthcare Facilities could implement the HITECH Act of 2009. It since then has gone international and the NLM is the U.S. member. It is now called IHTSDO.

Question 8.10: (d) Nursing Diagnosis, Intensity of Nursing Care, Nursing Outcome, and Nursing Intervention. The NMDS was created from consensus at a conference led by Harriet Werley and Norma Lang. It consists not only of the four Nursing care elements but also six Patient or Client Demographic Elements and seven Service Elements. Since its creation it has been accepted as the bases for the nursing terminologies recognized by the ANA.

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9

Human–Computer Interaction

• OBJECTIVES

1. Recognize theoretical underpinnings for Human–Computer Interaction.
2. Discuss Human–Computer Interaction principles.
3. Apply the use of Human–Computer Interaction principles to a healthcare model called Aging in Place.
4. Propose how the application of Human–Computer Interaction principles can improve nurse and patient outcomes in healthcare.

• KEY WORDS

Human–Computer Interaction
Patient care
Information technology
Patient safety
System design
Nursing informatics

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give an example of a poorly designed product or software application. Does the design cause you to make errors? Do you think the product or software application was designed for you as the user? How could the design be improved? Can you give an example of a poorly designed product or software application in healthcare? How could the design be improved? What does human–computer interaction mean? Can you give an example? Why would an understanding of human–computer interaction be important in healthcare?

For a WIIFM statement, say to the class, "This chapter provides important information for nurses engaged in HCI efforts to improve healthcare systems and processes. The purpose of this chapter is to elevate nurses' understanding of the theoretical underpinnings of HCI approaches used to evaluate clinical technologies; to infuse HCI concepts by identifying important HCI approaches, during this time of rapid and continuous change; and finally, to describe how HCI evaluation can lead to improved performance and outcomes in nurse-led systems." As a nurse, it is important to understand human–computer interaction, human-centered design as well as the evaluation techniques of clinical technologies.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook.
2. Encourage students to visit Internet Web sites relevant to the chapter topic.

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Teaching Tip

Provide the following as background information regarding Human–Computer Interaction. Human–Computer Interaction (HCI) is broadly defined as an intellectually rich and highly

(*continued*)

impactful phenomenon influenced by four disciplines: (1) Human Factors/Ergonomics, (2) Information Systems, (3) Computer Science, and (4) Library and Information Science (Grudin, 2012). Aspirations of fledgling HCI researchers and practitioners, over the past 30 years, were to develop better menus, enhance use of graphical user interfaces, advance input devices, construct effective control panels, and improve information comprehension (Shneiderman, 2012). There are few fields, like HCI, which can claim such a rapid expansion and strong influence on the design of ubiquitous technologies including desktops, Web, and mobile devices used by at least 5 billion users around the world (Shneiderman, 2012). This chapter provides important information for nurses engaged in HCI efforts to improve healthcare systems and processes. The purpose of this chapter is to elevate nurses' understanding of theoretical underpinnings for HCI approaches used to evaluate clinical technologies; to infuse HCI concepts by identifying important HCI approaches, during this time of rapid and continuous change; and finally, to describe how HCI evaluation can lead to improved performance and outcomes in nurse-led systems.

Human Factors: A Building Block for Human–Computer Interaction

1. Human factors is a discipline that optimizes relationships between technology and humans
2. Human factors has been defined in a number of ways by a number of experts
3. In healthcare, human factors experts attempt to understand relationships between humans, tools they use (i.e., computers), living and work environments, and tasks they perform
4. Human factors experts apply information about human characteristics and behavior to determine optimal design specifications for tools people use in their daily life

Teaching Tip

Provide the following example, the goal of a human factors approach in nursing is to optimize the interactions between nurses and the tools they use to perform their jobs, minimize error, and maximize efficiency, optimize well-being, and improve quality of life.

5. HCI is concerned with interactions between people and computers, is an area of study concentrated on by human factors experts
6. HCI is defined as the study of how people design, implement, and evaluate interactive computer systems in the context of users' tasks and work
7. HCI emerged in the 1980s as an interdisciplinary field incorporating ideals of
   a. Computer science
   b. Cognitive science
   c. Human factors engineering professionals
8. HCI has grown into a science incorporating concepts and approaches from many other disciplines
9. An excellent history of HCI is written by Grudin and can be found in the *Human–Computer Interaction Handbook*
10. Some critics believe current descriptions of HCI require broader definitions
11. Critics suggest that current definitions do not reflect
    a. Ubiquitous
    b. Pervasive
    c. Social
    d. Embedded
    e. Invisible user-oriented technologies
12. Some HCI critics want to move beyond computer use to emphasize the other components of HCI including
    a. User experience
    b. Interaction design
    c. Emotional impact
    d. Aesthetics
    e. Social engagement
    f. Empathetic interactions
    g. Trust building
    h. Human responsibility

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Frameworks for HCI in Nursing

1. Early pioneers in nursing informatics set the stage for the development of nursing information systems and their use in
   a. Storing information
   b. Knowledge development
   c. Development of technology in caregiving activities
2. These early models had several limitations including
   a. A lack of environmental and task-oriented elements
   b. Conceptual differences across frameworks
   c. And a lack of time dimensions
3. Nursing frameworks were proposed to illustrate dynamic interactions occurring between nurses, computers, and enabling elements that optimize a user's ability to process information via computers
4. These became the early foundations for incorporating human factors approaches into the design of information technologies used by nurses
5. There were still limitations identified in these early models because they did not
   a. Explicitly make the patient part of the model
   b. Define the context
   c. Or include all elements of nursing's metaparadigm
6. Effken proposed the Informatics Research Organizing Model which emphasized all elements of nursing's metaparadigm including the system, nurse, patient, and health
7. Later, Alexander's Nurse—Patient Trajectory Framework was proposed

8. Alexander's framework utilizes
    a. Nursing process theory
    b. Human factors
    c. Nursing and patient trajectories as components of a framework that can be used to evaluate patient care systems
    d. The midrange framework specifically emphasizes the use of human factors approaches to link patient care processes, nurse and patient trajectories, and nursing and patient outcomes
    e. In this discussion, the framework has been modified to explore HCI in the context of nurse and patient trajectories as technology is integrated into nurse-led systems
    f. Examples of HCI design and research using this model will be used to achieve the objectives

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Designing for HCI

1. The discipline of HCI incorporates proponents of interaction design
2. Interaction designers are concerned with shaping digital things for peoples' use
3. Concepts proposed by interaction designers in healthcare have significant implications for design of pervasive technologies that are being developed and adopted by healthcare providers and patients
4. Interaction designers are characterized as shaping and transforming processes through the use of digital devices
    a. They consider all possible futures for a digital design space
    b. Designers frame a problem at the same time they are creating a solution
    c. Designers address instrumental and technical aspects of digital media
    d. But also recognize aesthetic and ethical aspects of designs

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Aging in Place: An Example of Interaction Design

1. One problem for the millions of older adults who have multiple chronic illnesses is that they want to remain at home as long as possible
2. However, at the end of life, these chronic illnesses result in
    a. Greater frailty
    b. Decline in independent daily activities
    c. And greater safety concerns, such as falls
3. As these conditions progress often older adults experience reduced mobility with greater isolation from their peers
4. Solutions to problems faced by these frail individuals are needed to
    a. Help them age in place
    b. And to have better experiences at the end of their life
5. Solutions for these problems are being developed by an interdisciplinary team of software designers at the University of Missouri in an independent living facility called TigerPlace
6. To maximize efforts, the formation of an interdisciplinary interaction design team was critical in initial and ongoing stages of developing solutions for these age-old problems
7. The multidisciplinary team included
    a. Nurses
    b. Physicians
    c. Sociologists
    d. Computer engineers
    e. Architectural designers
    f. Informatics specialists
8. Rich dialogue was produced from multiple perspectives that enhanced our ability to produce a wide variety of solutions, including embedded sensor systems that assisted in early detection of declining health experienced by older adults living in TigerPlace
9. While developing these solutions the design team concurrently considered crucial aspects of HCI design such as
    a. Aesthetics
    b. Ethics
    c. Usability
    d. User experience
10. Examples are drawn from these experiences to demonstrate principles of HCI design

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Aesthetics in HCI

1. Aesthetics has been defined as "of or relating to beauty" and "pleasing in appearance: ATTRACTIVE [easy to use keyboards, clear graphics, and other ergonomic and aesthetic features]"
2. Aesthetics influences cognitive and emotional processes of people who interact with technology
3. Aesthetics are a strong determinate of user satisfaction and pleasure, which are important HCI outcome metrics
4. Traditionally, HCI researchers have emphasized objective performance criteria, such as
    a. Time to learn
    b. Error rates
    c. Task completion times
    d. Other aspects, such as aesthetics, have been neglected

5. In the current context, aesthetics refers to the beauty and pleasing appearance of technological artifacts designed to solve complex health-related problems

Teaching Tip
Use the following as a case study for the class. The students, working in teams of 3–4 students, should review the case study regarding how aesthetic design was used for aging in place technologies for TigerPlace. Ask the student teams to describe how they would use aesthetic design in another clinical setting. The students should report their findings back to the class.

Aesthetics for Aging in Place Technologies *Referring back to our Aging in Place HCI model, our team has found that aesthetic design features influence the adoption of technologies by patients who want to age in place; additionally, aesthetics are important to healthcare providers whose healthcare decisions are influenced during interactions with the technology. As an example of aesthetic appeal, we will use descriptions of the functional components of our IT system used by patients and providers who live and work, respectively, with our sensor system. Aesthetic design has important ramifications for patient and provider trajectories in Alexander's framework. The influence of aesthetic appeal for our users has important implications for technology acceptance in the lived environments of our patients, and for providers.*

Information about how the TigerPlace sensor system operates can be found in past publications. We'll provide a brief description here. TigerPlace residents who consent to have sensor systems have the option of having motion sensors placed throughout their apartment that detect motion, location, and functional activity levels in each room and in certain places, such as opening the refrigerator or turning on the stove. Another option, for TigerPlace residents, is to have a water-filled sensor installed under their mattress on their bed that detects bed restlessness, breathing patterns, and heart rate, while they are lying on the bed. Another option, for residents, is technology that captures gait parameters including most used walking paths and fall detection images. All of this data is collected in a secure server, accessed only by research staff with proper authorization. The data can be viewed via a computer interface which we have developed with HCI methods.

Residents, who live at TigerPlace, have expressed aesthetic concerns about the technology, which have influenced our product design and implementation in residents' apartments. In the initial stages of product development, the design team made a conscious decision to make all the technologies as noninvasive to the users as possible, including deploying technologies that are not worn by end users. The design team decided that technologies that are worn may infringe on the independence of the older adults, and furthermore, could contribute to the stigma of frailty that older adults may experience. Older adults at TigerPlace expressed that they felt safer living with the technology, but they didn't want the technology to stand out. The invisibility of the technology was an important aesthetic design factor the team had to consider as we developed the product. HCI metrics that help us understand the perceptions of noninvasiveness and invisibility have been rarely measured, but are important considerations for prevailing IT systems that will be embedded where people live.

TigerPlace providers, nurse care coordinators, who care for TigerPlace residents want a system that can contribute to earlier detection of health decline for residents who are aging in place. However, a sensor system that captures activity data around the clock, 24/7, can be daunting to search through in order to make appropriate decisions about care coordination. One problem that designers faced was how to develop an interface that supports proper data visualization, of this big data, with good aesthetic appeal for end users. Using an interactive, iterative HCI process, the design team worked together with care coordinators to discuss concerns about the early illness warning system and suggest solutions. Figure 9.2 illustrates the outcome of this critical work engaging end users and software developers in the design process of an interface for our sensor system.

The design teams worked to incorporate colors along a longitudinal graph for each hour of each day, which we call a motion density map, to help providers easily detect resident activity level change. More vivid blues and yellows on the motion density map indicate greater activity levels, which are easily detectable, compared to the duller hues. Additionally, the design layout expedited the ability to detect important activity changes at different times of the day, such as, during the nighttime when residents should be sleeping (yellow and gray hues between midnight and 6:00 a.m.). Design aesthetics incorporated into longitudinal data is being used by healthcare providers to detect patient decline. The aesthetic design of these interfaces is crucial to facilitate proper use and detection of early illness decline experienced by residents and observed for by providers.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Ethics in HCI

1. Perceptions have been that information technology can help
    a. Improve diagnostic accuracy
    b. Make information more accessible
    c. Can improve the representation of facts in medical records
2. Ethical considerations for HCI are becoming paramount with the everywhereness of technology embedded throughout our world and the robust forms of technology being used

Teaching Tip
Use the following as an example. Consider the example of designing for mobile platforms; three main problem areas of design have been proposed for these types of devices including use of screen space, interaction mechanisms, and design of mobile user interfaces (Nilsson, 2009).

3. Designers assume great responsibility to address these problems by designing in solutions that optimize use of these platforms, while minimizing potential pitfalls of HCI design problems
4. Mobile healthcare platforms, such as,
    a. Telemonitoring equipment
    b. Web-based support systems
    c. Bedside clinical decision support systems to help frontline nurses manage critical symptom changes, are a few examples
5. Designers assume an ethical responsibility to test these platforms using HCI methods
    a. Not only in controlled settings during early stages of development life cycles
    b. But also at periods of implementation in the field where unintended consequences can occur

Teaching Tip

Use the following as a case study for the class. The students, working in teams of 3–4 students, should review the case study regarding ethics for aging in place technologies. What were some of the issues? Ask the students to apply the same techniques used in the case study to another clinical setting. The students should report their findings back to the class.

Ethics for Aging in Place Technologies *The sensor technologies being used at TigerPlace have been incorporated into the living environments of residents choosing to age in place at this facility. Future use of these sensors includes possible interactions with other types of users, such as families, physicians, nurses. So, their input into the development of this technology is critical during all stages of development and implementation.*

In order to meet ethical obligations to the public who will eventually use these sensor systems, the design team incorporated multiple HCI methodologies to examine user's perceptions of the interface and to examine the functionality of the interface. For instance, our team conducted many key informant interviews with residents living with sensors to explore their lived experiences with the sensor systems. Finally, we conducted task-oriented usability assessments that were electronically documented with usability software, called Morae, with each type of end user (residents, families, nurses, physicians). Through these usability assessments the design team identified potential problem areas encountered during interactions for each user type. Again, these findings were used by software designers to improve the functionality, aesthetics, and appearance of the sensor interface. Usability methodologies are important to meet ethical obligations of software design.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Usability in HCI

Teaching Tip

Provide the following as information to the students. Usability evaluation determines the extent that a technology is easy and pleasurable to use by determining if it is well adapted to users, their tasks, and that negative outcomes are minimized as a result of use. Usability evaluation has been a staple of HCI researchers for the past 30 years and continues to grow in prominence as technology advances have been made around the world. HCI designers have proposed that usability is inherently measureable in all electronic technologies, that usability evaluation determines if an interactive system is usable, and if a system is usable, then usability evaluation can determine the extent of usability using hardy usability metrics, and finally, that usability evaluation is an accessible form of analysis and easy enough to learn about in HCI literature. There are a large number of methods available for designers to use to assess the usefulness of a piece of medical technology.

1. Contextual inquiry (CI)
    - **a.** Contextual inquiry is qualitative in nature and derived from ethnography
    - **b.** Which focuses on scientific descriptions and illustrations of social groups and systems
    - **c.** Contextual inquiry is usually conducted in the field using extensive, well designed, systematic observations to capture how people interact with technology in real-world settings
    - **d.** Through this method the researcher becomes immersed in the group or system to understand how interactions take place
    - **e.** This method provides rich data that can be voluminous depending on the number of settings involved, time spent in the settings, and the number of observations captured in the setting
    - **f.** Typically, sample subjects are key informants who have specialized knowledge, status, or skills which are of interest to the researcher
    - **g.** Often times one, two, or more subjects can be observed individually or in dyads over periods of time to understand how interactions take place or how technology may influence interactions
    - **h.** Decisions about the sample and settings also have impacts on costs of conducting contextual inquiry research, which can be high
    - **i.** Researchers using contextual inquiry methods use their interpretations of observations as a source to answer important questions about social groups or systems
    - **j.** In many studies, other methods are used concurrently with contextual inquiry, such as focus groups, in order to validate researchers' interpretations of phenomena observed in the field
2. Cognitive task analysis
    - **a.** Cognitive research is used to describe psychological processes associated with the acquisition, organization, and use of knowledge
    - **b.** Cognitive processes in human–machine interactions are complex and involve continuous exchanges of information between operators and the machines they use, which is a type of shared cognition
    - **c.** For example, nurses and physicians work in tandem to deliver optimal care for each patient
    - **d.** The design of human–machine interfaces such as nursing and physician interfaces used for documentation and medical record review must consider the nature of interdisciplinary work
    - **e.** Unfortunately, studies typical of evaluating nursing workflow disruption have not been a focus in similar studies assessing physician workflow

Teaching Tip

Provide the following example. For instance, investigating how nursing roles and activities are affected by physician orders when implementing a clinical information system would provide valuable design input for electronic medical record designs

- **f.** Medical devices are also an important human–machine interface which are sometimes shared and need to be tested collaboratively by interdisciplinary healthcare teams

Teaching Tip

Provide the following example, but these evaluations are limited; such as, evaluations including both nurses and pharmacists should provide important design considerations for computerized order entry for pharmacy and medication administration systems to ensure safe execution of orders and delivery of medications.

g. Cognitive processes in human–machine systems involve the
  (1) Operator providing input to the machine, the machine acting on the input and displaying information back to the operator
  (2) Operator processes information through sensing mechanisms such as visual, auditory, somatosensory, and vestibular systems
  (3) Finally, the operator determines if the information from the machine is accurate, providing correct communication, decides what actions to take, and provides new input to the machine

h. Attempts to understand and exploit human capabilities and strengths within the area of human cognitive ability are critical to the safe design of technology

i. Safe design includes responses to human stress and is an important variable in HCI research

Teaching Tip

Provide the following example. The ability of a nurse to make timely and accurate decisions and to be vigilant of machine alarms during periods of sleep deprivation while working several 12 hour night shifts in a row is a common work scenario that is worthy of attention in HCI research

j. Furthermore, human factors experts in nursing have begun using mapping techniques called link analysis to map the cognitive processes of nursing work to understand what
  (1) Stresses
  (2) Or interruptions nurses' encounter during work, which contribute to cognitive delay

Teaching Tip

Provide the following example. Nonlinearity of nursing work, which requires frequent shifts in the process of delivering care, results in interruptions and delays in care that contribute to unsafe environments.

k. Understanding cognitive abilities of operators in the healthcare sector provides better understanding of physical and operational structures that affect clinical decision making and clinical reasoning that may lead to potential system failure

l. Cognitive task analysis used to evaluate task load has been used in healthcare settings

m. These types of analyses are typically qualitative in nature and involve interactions with "real" users to inform the design of new devices, which have usability outcomes already established

Teaching Tip

Use the following. Examples of CTA, in healthcare research, include the identification of potential errors performed with computer-based infusion devices used for terbutaline administration in preterm labor; to evaluate cognitive and physical burdens during period of high workload and stress while using computer-based physiologic monitoring systems in cardiac anesthesia; and to gain new perspectives in the work of nursing processes to understand how disruptions can contribute to nursing error in acute care environments.

3. Usability tests

a. The definition of usability is "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use"

b. Usability evaluations are viewed as a critical component to inform all stages of medical device product development from initial concepts through evaluation

c. The potential impacts of well-designed usability studies for medical devices are reduced user errors and intensification of patient safety efforts

Teaching Tip

Provide the following example. The National Institute of Standards and Technology in the U.S. Department of Commerce issued a report describing why usability of electronic medical records is critical. In the report, the authors outline a three-step process for electronic health record evaluation and human user performance testing including: (1) during the electronic health record design stage, users, work settings, and workflows are documented to determine possible system usability problems and to develop a working model that minimizes potential safety risks; (2) conduct an expert analysis comparing the prototype interface designs to rigorously established design standards, such as heuristics discussed next, in order to establish estimates of effectiveness, efficiency, and potential risks; and finally (3) examine critical tasks to be performed with real users documenting objective performance measures, such as task completion times, number of errors, and failures.

d. Subjective measures are important to identify, such as mismatches between user expectations identified during periods when users are encouraged to think aloud about their experiences

e. Subjective measures can be measured with simple usability scales, as the System Usability Scale

f. The System Usability Scale is freely available for researchers

g. These processes, if conducted in a rigorous way, could be applied to any medical device usability evaluation, not just electronic health records

h. Usability studies are often conducted in labs during early conceptual and prototype stages of a project

i. However, usability studies should also be conducted in the final evaluation stages in the field

j. This is important because field experiments can bring about unintended consequences due to workflows and processes encountered by users during interactions with devices

   k. There is evidence in the literature that field studies are not conducted as often as they should be for crucial medical devices being implemented in patient care settings
   l. Reasons for a lack of usability studies in the field could be
      (1) Increased costs
      (2) Disruptions to services from excessive time commitments required for these types of assessments

4. Heuristics
   a. This type of HCI evaluation involves a small group of experts, who evaluate quantitatively how well a device meets established design standards, called heuristics
   b. Procedures for a heuristic evaluation are part of an iterative design process that enables identification and, hopefully, elimination of potential risks that may cause dangerous outcomes

Teaching Tip
Use the following as a case study for the class. The students, working in teams of 3–4 students, should review the case study regarding the use of heuristics. What were some of the heuristic issues? Ask the students to identify and describe another clinical situation where heuristics could be used. The students should report their findings back to the class.

For example, designers of the Aging in Place sensor system, discussed throughout this chapter, supported an extensive heuristic analysis of the sensor data display using three outside experts who were trained in HCI methods. The sensor data display was evaluated against 16 heuristics, which included 96 heuristic criteria total, during the conceptual phase, before it was deployed in the clinical setting where care coordinators use the sensor interface to coordinate care. The assessment was conducted in a usability lab where the expert reviewers could interact with the sensor interface. Many recommendations were made by reviewers to the design team to improve the sensor data interface, which were incorporated into the subsequent interface designs. The heuristic evaluation resulted in 26 recommendations for design change. Findings were classified according to their importance, the most important being heuristic criteria that were not met. The most important design changes that were not met included flexibility and efficiency of use of the interface due to lack of functional descriptions of interface components provided, help and frequently asked question (FAQ) documentation that were provided to users, lack of the interface to support all skill levels of users, and poor navigational issues related to lack of feedback about where users were located in the system during interactions. Positive ratings were given heuristic criteria related to aesthetic appeal of the interface and minimalist design. Through this process the design team was able to identify weaknesses in system design prior to implementation, responded by redesigning the interface to strengthen support of these established criteria, and reducing the risk of potential negative outcomes of use of the system.

5. Cognitive walkthrough

Teaching Tip
*Provide the following information***.** *Similar to heuristic evaluation, cognitive walkthrough is conducted using expert evaluators who are not necessarily part of the population of end users of a technological device. Cognitive walkthrough evaluations are task specific, as compared to heuristic evaluation, which provides a holistic view of the interface and system features. To be successful an investigator conducting a cognitive walkthrough must be aware of who are the systems users, what tasks are to be analyzed, sequences of tasks to be conducted, and evaluators must know how the interface functions. This means that evaluators must be familiar with tasks, their composition, how tasks are allocated, and feedback given in response to tasks.*

   a. Tasks
      (1) Tasks involve interplay between physical and cognitive activities and may be considered to follow a continuum between nearly pure physical tasks, such as transporting a patient to an X-ray, to nearly pure cognitive tasks, such as assessing hemodynamic status
      (2) Tasks tend to describe discrete, detailed behaviors needed to carry out functions and functions tend to describe continuous, macro-level behaviors, such as analyzing or detecting
   b. Task composition
      (1) A task or action sequence starts with a goal, then steps are initiated based upon user intentions, followed by the sequence of actions to be performed or intended to be performed, and the steps in the execution of the task
      (2) After tasks are executed, they are evaluated based on user perception, interpretation, and evaluation of the interpretations of the actions
      (3) Task structures may be shallow, narrow, wide, and deep

Teaching Tip
Provide the following as an example. Most everyday tasks, which occupy most of a human's time, are considered shallow, narrow structures that are opportunistic in nature, requiring little complexity in analysis and minimal conscious activity.

      (4) In shallow and narrow structures, humans need only examine alternative actions and act
      (5) Alternatively, wide and deep structures require a considerable amount of conscious planning and thought, and usually require deliberate trial and error functions
   c. Feedback
      (1) Conditions that have been found to hinder feedback in healthcare environments include
         i. Incomplete awareness that system failures have occurred
         ii. Time and work pressures
         iii. Delays in action or outcome sequences
         iv. Case infrequence
         v. Deficient follow-up
         vi. Failed communication
         vii. Deficient reporting systems
         viii. Case review biases
         ix. Shift work and handoffs

- **(2)** Feedback is an important element that may be derived from display information in Human–Computer interactions
- **(3)** Feedback is important in the perception, implementation, and evaluation of tasks
- **(4)** Not all system feedback mechanisms are technical in nature
- **(5)** Sometimes feedback mechanisms are created through
  - **i.** Human quality audits
  - **ii.** Peer reviews
  - **iii.** Data mining
- **(6)** Emotional risks associated with the failure to provide feedback include
  - **i.** Loss of confidence
  - **ii.** Uncertainty about performance
  - **iii.** Increased stress

Teaching Tip

Provide the following example. Feedback mechanisms have been recognized as important components in nurse–computer interactions. Improvements have been recognized in the visibility and standardization of coordination of care mechanisms in wireless computerized information systems in nursing home information systems. In these settings, improved feedback mechanisms positively affected staff documentation and communication patterns in automated wireless nursing home environments where mobile devices were used by nurse assistants to document activities of daily living as they occurred; simultaneously, nurses were able to see what cares had been completed and outcomes related to the care. This seamless transition resulted in better quality and efficiency of patient care.

In other reports evaluations of response times to critical laboratory results using automated feedback mechanisms resulted in decreased response times following an appropriate treatment order. Information technologies that facilitate transmission of important patient data can improve the quality of care.

6. Focus groups
- **a.** Focus groups are an excellent method to cumulate rich qualitative descriptions of how people interact with technological systems
- **b.** These are low-cost methodologies which require little overhead to conduct
- **c.** Focus groups can provide a significant amount of information about
  - **(1)** Usefulness of technologies
  - **(2)** System processes
  - **(3)** Satisfaction of people using technology
- **d.** Focus group methodologies can be used throughout all product design stages
- **e.** Usually involve small groups of users being interviewed by a researcher who is interested in a specified phenomenon familiar to the users
- **f.** Focus groups are usually conducted
  - **(1)** In a controlled environment to avoid distraction
  - **(2)** Where people can feel free to share openly about their experiences
- **g.** Typically, focus groups are conducted using well thought out questions, which are used by researchers to maintain some methodological consistency
- **h.** Taking time to think about these questions ahead of time will
  - **(1)** Enhance reliability
  - **(2)** Reduce bias that could be introduced by randomly questioning participantsi. Data from multiple focus groups are usually analyzed for emerging themes that help support the research question
- **j.** Data are analyzed until data saturation is reached and all themes are realized from the data

7. Delphi technique
- **a.** The Delphi technique is used to gain consensus from experts on a subject
- **b.** This method uses multiple rounds of data collection from experts
- **c.** With each round using data from previous rounds
- **d.** The questions posed focus on the
  - **(1)** Opinions
  - **(2)** Forecasts
  - **(3)** Judgments of experts on a specific topic
- **e.** Each round of questions completed are
  - **(1)** Analyzed
  - **(2)** Summarized
  - **(3)** Returned to the experts with a new questionnaire
- **f.** With each round of questions experts look over previous information provided by the group and formulate opinions based on the whole group's feedback until a consensus is reached
- **g.** This process of response
  - **(1)** Feedback and response are usually repeated at least three times
  - **(2)** Or until a general group consensus is obtained
- **h.** Benefits of this methodology
  - **(1)** Is acquiring input from multiple experts who may be geographically dispersed
  - **(2)** Overhead and costs are generally low to conduct the method
- **i.** Some limitations to this method is
  - **(1)** That it can be time consuming
  - **(2)** And the cooperation of consensus panel members might be reduced over the length of the study

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

OUTCOMES IN HCI

- Traditional outcomes associated with HCI methods are efficiency, effectiveness, and satisfaction, which, as stated, are highly related to how usable a piece of technology is
- These outcomes have been a longstanding, central feature of HCI for many years
- With current emphasis by national institutes, such as National Institute of Standards and Technology, on incorporating HCI methodologies into the life cycle of developing technologies, HCI principles and methods will continue to grow in importance
- Theoretical frameworks or models of clinical care using any form of technology should incorporate HCI outcomes related to both clinician and patient
- For example, satisfaction with particular technologies will differ depending on whether the interaction being evaluated is between a patient and a computer or a nurse and a computer
- In the examples used throughout this chapter, the patients who are aging in place, living with sensor systems, have a very different set of expectations, compared to nurses who are using the sensor system for early detection of health decline and care coordination
- Patients claim they feel safer living with the technology, but they are not necessarily interested in seeing or using the data being collected by the sensors
- Nurses have shown that the sensor data is useful in helping to predict early illness decline, but tracking big data longitudinally present some unique challenges in data visualization and prediction of health events
- As new forms of technologies evolve, traditional HCI outcomes may require updating to keep pace with development

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Recognize theoretical underpinnings for Human–Computer Interaction
- Discuss Human–Computer Interaction principles
- Apply the use of Human–Computer Interaction principles to a healthcare model called Aging in Place
- Propose how the application of Human–Computer Interaction principles can improve nurse and patient outcomes in healthcare

Teaching Tip
Ask the students to define the keywords

- Human–Computer interaction
- Patient care
- Information technology
- Patient safety
- System design

CHAPTER REVIEW QUESTIONS

Question 9.1: What are the four disciplines that impact on the phenomenon of Human–Computer Interaction?

a. Computer Science, Security and Privacy, Graphical Interface, and Information Science

b. Library Science, Computer Science, Graphical Interface, and Ergonomics

c. Ergonomics, Information Systems, Computer Science, and Library Science

d. Information Science, Security and Privacy, Ergonomics, and Computer Science

Question 9.2: Which best defines Human–Computer Interaction (HCI)

a. HCI represents how people design, implement, and evaluate interactive computer systems True ___ False ___

b. HCI is concerned with human factors that optimize relationships between technology and humans True ___ False ___

c. HCI is concerned with cognitive science True ___ False ___

d. HCI represents Graphical Interface Tools True ___ False ___

e. HCI is concerned with Security and Privacy issues True ___ False ___

Question 9.3: What are the critical components utilized in Alexander's Nurse-Patient Trajectory Model?

a. Patient Outcomes, Nursing Process, and Physiological Monitoring

b. Physiological Monitoring, Human Factors, and Nursing Outcomes

c. Nursing Process Theory, Human Factors, and Nurse and Patient Trajectories

d. Nurse and Patient Trajectories, Physiological Monitoring, Patient Outcomes

Question 9.4:What are some examples of a TigerPlace Sensor System?

a. Gait Parameter, Walking Counter, and Motion Sensors

b. Motion Sensors, Bed Water-Filled Sensors, and Gait Parameters

c. Bed Water-Filled Sensors, Sleep Sensors, and Balance Sensors

d. Motion Sensors, Gait Parameters, and Balance Sensors

Question 9.5: What are the ethical considerations for HCI?

a. Use of screen space, interactive mechanisms, and mobile user interfaces

b. Design issues with selection of hardware architecture, and screen space

c. Issues with terminology selection, screen space, and hardware architecture

d. Design issues of software selection, user interfaces, and screen space

Question 9.6: How is Usability Evaluation determined?

a. How well adapted by their tasks, and positive output that is maximized

b. How well adapted by users, their tasks, and that negative output is minimized

c. How well adapted by patients and their interactive system usability

d. How well adapted by users, patients, and developers

Question 9.7: What are some examples of the Operator's cognitive processes in human–machine interactions?

a. The Operator's reviews the software used to process data, reviews input and output for accuracy, and communicates with the users for feedback

b. The operator's program is designed to process the devices for output and usability as well as review the input

c. The operator generates data to evaluate evidence-based output and compares it to input data

d. The operator provides input, processes information, checks the accuracy of the output, and provides correct communications regarding actions to take

Question 9.8: What are the three specific products that can be used to meet the usability goals?

a. Safety, Quality Use, and Effectiveness

b. Effectiveness, Efficiency, and Satisfaction with its Use

c. Satisfaction with Use, Efficiency, and Safety

d. Quality of Use, Safety, and Efficiency

Question 9.9: What are the three-step process for electronic health record (EHR) evaluation and human–user performance testing?

a. Develop a working model to minimize safety risks, conduct an expert analysis comparing prototype design, and examine critical tasks performed by the real users

b. Develop a working model to minimize safety risks, evaluate the output uses, and develop workload measures

c. Examine critical tasks performed by the real user, conduct an expert analysis comparing prototype design, and develop a framework model

d. Conduct an expert analysis comparing prototype design, evaluate the output uses, and develop a working model to minimize safety risks

Question 9.10: What are the traditional outcomes associated with HCI methods?

a. Only by how satisfied are the users of the technology

b. The efficiency, effectiveness, and satisfaction related to how usable is the technology

c. Only on how effective is the technology

d. On how efficient and effective is the technology

ANSWERS AND EXPLANATIONS

Question 9.1: c. Ergonomics, Information Systems, Computer Science, and Library Science.

Human–Computer Interaction (HCI) is broadly defined as an intellectually rich and highly impactful phenomenon influenced by four disciplines: (1) Ergonomics, (2) Information Systems, (3) Computer Science, and (4) Library Science.

Question 9.2:

a. True

b. True

c. True

d. False

e. False

Question 9.3: c. Nursing Process Theory, Human Factors, and Nurse and Patient Trajectories.

Alexander's Nurse-Patient Trajectory Model was proposed in 2007, which utilizes nursing process theory, human factors, and nursing and patient trajectories as components of a framework that can be used to evaluate patient care systems.

Question 9.4: b. Motion Sensors, Bed Water-Filled Sensors, and Gait Parameters.

TigerPlace sensor system is a place where residents consent to have motion sensor systems placed throughout the apartment that detect motion, location, and functional activity levels in each room, for example, when opening the refrigerator or turning on the stove.

The technology uses a secure server to collect the responses and which can only be accessed by research staff with proper authorization.

Question 9.5:

a. Use of screen space, interactive mechanisms, and mobile user interfaces.

The ethical considerations for HCI impact on the designers who have the responsibility of addressing the problems impact on the users by designing solutions that optimize the use of the selected platforms while minimizing potential pitfalls.

Question 9.6:

b. How well adapted by users, their tasks, and that negative output is minimized.

Usability evaluation is determined by the extent that a technology is easy and pleasurable to use by determining if it is well adapted to the users, their tasks, and that negative outcomes are minimized as a result of use.

Question 9.7:

d. The operator provides input, processes information, checks the accuracy of the output, and provides correct communications regarding actions to take.

The Operator's cognitive processes in human–machine interactions are complex and involve continuous exchanges of information between operators and the machine they use, which is a type of shared cognition. For example, the design of the HCI interface between nursing and physician interfaces used for documentation and medical record review must consider the nature of the interdisciplinary work.

Question 9.8:

b. Effectiveness, Efficiency, and Satisfaction with its Use.

The International Organization for Standardization (ISO) definition of usability is "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO/IEC 1998).

Usability evaluations are viewed as a critical component to inform all stages of medical device product development from initial concepts through evaluation.

Question 9.9:

a. Develop a working model to minimize safety risks, conduct an expert analysis comparing prototype design, and examine critical tasks performed by the real users.

In 2012 by the National Institute of Standards and Technology in the U.S. Department of Commerce published a report on why the electronic medical record is critical. The authors outlined a three-step process for electronic health record evaluation and human user performance testing listed above.

Question 9.10:

b. The efficiency, effectiveness, and satisfaction related to how usable is the technology.

The three stated outcomes associated with HCI methods are highly related to how a piece of technology is. These outcomes have been a longstanding central feature of HCI for many years and are recommended outcomes related to both clinician and patient.

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10

Trustworthy Systems for Safe and Private Healthcare

• OBJECTIVES

1. To explain the critical role that "trustworthiness" plays in healthcare quality and safety.
2. To explain the relationship among security, privacy, and trust.
3. To propose adherence to fair information practices principles as essential to privacy and trust.
4. To introduce and describe a trust framework comprising seven layers of protection essential for protecting sensitive and safety-critical health information and services.

• KEY WORDS

Health information technology
Trustworthy systems
Security
Privacy
Fair Information Practices Principles

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: How do you maintain the privacy and security of your personal computer? Have you ever had a virus or malware on your computer? How did you remove it from your computer? Why is it important to maintain the privacy and security of health information? Can you provide examples when breaches have occurred at healthcare organizations? How can healthcare organizations maintain the privacy and security of health information? How can healthcare organizations prevent attacks to computers and networks?

For a WIIFM statement, say to the class, "In this chapter, we will explain the critical role that trustworthiness plays in HIT adoption and in providing safe, private, high-quality care. We will introduce and describe a trust framework comprising seven layers of protection essential for establishing and maintaining trust in a healthcare enterprise." As a nurse, it is important to understand how to maintain the privacy, confidentiality, and security of health information.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook.
2. Encourage students to visit Internet Web sites relevant to the chapter topic.

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Introduction

Teaching Tip

Provide the following as information, the healthcare industry is in the midst of a dramatic transformation that is changing everything from frustrating and costly administrative inefficiencies, to how conditions are diagnosed and treated, to how biomedical science advances. This transformation is driven by a number of factors, most prominently the skyrocketing cost of healthcare in the United States; the exposure of care-related, patient-safety

(*continued*)

problems; advances in genomics and "big data" analytics, and an aging, socially networked population that expects the healthcare industry to effectively leverage information technology to manage costs, improve health outcomes, advance medical science, and engage consumers as active participants in their own health.

1. The U.S. Health Information Technology for Economic and Clinical Health (HITECH) Act that in 2009 was enacted as part of the American Recovery and Reinvestment Act
   - **a.** Provided major structural changes
   - **b.** Funding for research, technical support, and training
   - **c.** Financial incentives designed to significantly expedite and accelerate this transformation
2. The HITECH Act
   - **a.** Codified the Office of National Coordinator (ONC) for health information technology (HIT)
   - **b.** Assigned ONC responsibility for developing a nationwide infrastructure
   - **c.** That would facilitate the use and exchange of electronic health information
   - **d.** Including policy, standards, implementation specifications, and certification criteria
3. In enacting the HITECH Act, Congress recognized that the meaningful use and exchange of electronic health information was key to improving the quality, safety, and efficiency of the U.S. healthcare system
4. The HITECH Act recognized that as more health information was recorded and exchanged electronically to
   - **a.** Coordinate care
   - **b.** Monitor quality
   - **c.** Measure outcomes
   - **d.** Report public health threats
   - **e.** The risks to personal privacy and patient safety would be heightened
5. This recognition is reflected in the fact that four of the eight areas the HITECH Act identified as priorities for the ONC specifically address risks to individual privacy and information security:
   - **a.** Technologies that *protect the privacy* of health information and *promote security* in a qualified electronic health record, including for the *segmentation and protection from disclosure* of specific and sensitive individually identifiable health information, with the goal of minimizing the reluctance of patients to seek care (or disclose information about a condition) because of privacy concerns, in accordance with applicable law, and for the use and disclosure of *limited data sets* of such information
   - **b.** A nationwide HIT infrastructure that allows for the electronic use and *accurate exchange* of health information
   - **c.** Technologies that as a part of a qualified electronic health record allow for an *accounting of disclosures* made by a covered entity (as defined by the Health Insurance Portability and Accountability Act of 1996) for purposes of treatment, payment, and healthcare operations
   - **d.** Technologies that allow individually identifiable health information to be *rendered unusable, unreadable, or indecipherable to unauthorized individuals* when such information is transmitted in the nationwide health information network or physically transported outside the secured, physical perimeter of a healthcare provider, health plan, or healthcare clearinghouse
6. The HITECH Act resulted in most significant amendments to the Health Insurance Portability and Accountability Act (HIPAA) Security and Privacy Rules since the rules became law

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Maintaining Trust, Despite Increasing Risk

1. As noted by former National Coordinator David Blumenthal, M.D., M.P.P., "Information is the lifeblood of modern medicine. Health information technology is destined to be its circulatory system
2. Without that system, neither individual physicians, nor healthcare institutions can perform at their best or deliver the highest-quality care"
3. To carry Dr. Blumenthal's analogy one step further, at the heart of modern medicine lies "trust"
4. Caregivers must trust that the technology and information they need will be available when they are needed at the point of care
5. They must trust that the information in a patient's electronic health record (EHR) is accurate and complete and that it has not been accidentally or intentionally corrupted, modified, or destroyed
6. Consumers must trust that their caregivers will keep their most private health information confidential
7. Consumers must trust that caregivers will disclose and use their health information only to the extent necessary and in ways that are
   - **a.** Legal
   - **b.** Ethical
   - **c.** Authorized consistent with individuals' personal expectations and preferences
8. Above all else, consumers must trust that their caregivers and the technology they use will "do no harm"
9. The nursing profession is firmly grounded in a tradition of
   - **a.** Ethics
   - **b.** Patient advocacy
   - **c.** Care quality
   - **d.** Human safety
10. The registered nurse is well indoctrinated on clinical practice that respects personal privacy and that protects confidential information and life-critical information services
11. The American Nurses Association's (ANA's) *Code of Ethics for Nurses with Interpretive Statements* includes a commitment to "promote, advocate for, and strive to protect the health, safety, and rights of the patient"

12. The International Council of Nurses (ICN) Code of Ethics for Nurses affirms that the nurse "holds in confidence personal information" and "ensures that use of technology … [is] compatible with the safety, dignity, and rights of people"
13. Fulfilling these ethical obligations is the individual responsibility of each nurse, who must trust that the information technology she relies upon will help and not harm patients and will protect their private information
14. Recording, storing, using, and exchanging information electronically do indeed introduce new risks

Teaching Tip

Provide the following, as anyone who has used e-mail or texting knows, very little effort is required to instantaneously send information to millions of people throughout the world. Try doing that with a paper record and a fax machine! We also know that nefarious "spyware," "viruses," and "Trojan horses" skulk around the Internet and insert themselves into our laptops, tablets, and smartphones, eager to capture our passwords, identities, and credit card numbers. At the same time, the capability to receive laboratory results within seconds after a test is performed; to continuously monitor a patient's condition remotely, without requiring him to leave his home; or to align treatments with outcomes-based protocols and decision-support rules personalized according to the patient's condition, family history, and genetics, all are enabled through HIT. As HIT assumes a greater role in the provision of care and in healthcare decision making, the nurse increasingly must trust HIT to provide timely access to accurate and complete health information and support for decision making, while assuring that individual privacy is continuously protected.

15. Legal and ethical obligations, as well as consumer expectations
    a. Drive requirements for assurance that data and applications will be available when they are needed
    b. That private and confidential information will be protected
    c. That data will not be modified or destroyed other than as authorized
    d. That systems will be responsive and usable
    e. That systems designed to perform health-critical functions will do so safely
16. These are the attributes of trustworthy HIT—technology that is worthy of our trust

Teaching Tip

Provide the following information, the Markle Foundation's Connecting for Health collaboration identified privacy and security as a technology principle fundamental to trust: "All health information exchange, including in support of the delivery of care and the conduct of research and public health reporting, must be conducted in an environment of trust, based on conformance with appropriate requirements for patient privacy, security, confidentiality, integrity, audit, and informed consent."

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Security and Privacy

1. Many people think of "security" and "privacy" as synonymous
2. These concepts are indeed related in that security mechanisms can help protect personal privacy by assuring that confidential personal information is accessible only by authorized individuals and entities
3. Privacy is more than security, and security is more than privacy
4. Healthcare privacy principles were first articulated in 1973 in a U.S. Department of Health, Education, and Welfare report entitled *Records, Computers, and the Rights of Citizens* as "fair information practice principles"
5. The Markle Foundation's Connecting for Health collaboration updated these principles to incorporate new risks created by a networked environment in which health information routinely is electronically captured, used, and exchanged
6. Based on these works, as well as other national and international privacy and security principles focusing on individually identifiable information in an electronic environment (including but not limited to health), the ONC developed a *Nationwide Privacy and Security Framework for Electronic Exchange of Individually Identifiable Health Information*
7. *Nationwide Privacy and Security Framework for Electronic Exchange of Individually Identifiable Health Information* identified eight principles intended to guide the actions of all people and entities that participate in networked, electronic exchange of individually identifiable health information
8. These principles essentially articulate the "rights" of individuals to openness, transparency, fairness, and choice in the collection and use of their health information
9. Whereas privacy has to do with individual rights, security deals with protection
10. Security mechanisms and assurance methods are used to protect
    a. The confidentiality and authenticity of information
    b. The integrity of data, and the availability of information and services
    c. As well as provide an accurate record of activities and access to information
11. These mechanisms and methods are critical to protecting personal privacy
12. They are essential in protecting patient safety and care quality—and in engendering trust in electronic systems and information

Teaching Tip

Provide the following as an example, if laboratory results are corrupted during transmission, or data in an EHR are overwritten, or if an electronic message claiming to have been sent by another health professional proves to be fraudulent, the nurse is likely to lose confidence that the HIT can be trusted to help her provide quality care. If a miscreant alters a clinical decision-support rule or launches a denial-of-service attack on a sensor system for tracking wandering Alzheimer's patients, individuals' lives are put at risk!

13. Trustworthiness is an attribute of each system component and of integrated enterprise systems as a whole—including those components that may exist in "clouds" or in coat pockets
14. Trustworthiness is very difficult to retrofit
15. Trustworthiness must be designed and integrated into the system and conscientiously preserved as the system evolves

Teaching Tip
Provide the example, discovering that an operational system cannot be trusted generally indicates that extensive—and expensive—changes to the system are needed.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

When Things Go Wrong

1. We would like to be able to assume that computers, networks, and software are trustworthy
2. Unfortunately, that is not the case
3. When computers, networks, and software fail in such a way that critical services and data are not available when they are needed, or confidential information is disclosed, or health data are corrupted, personal privacy and safety are imperiled

Teaching Tip
Provide the following example, one of the more dramatic examples was reported in the cover story for the February 2003 issue of *CIO Magazine*, which relates in detail the occurrence and recovery from "one of the worst healthcare IT crises in history"—a catastrophic failure in the network infrastructure that supported CareGroup, one of the most prestigious healthcare organizations in the United States. The source of the problem ultimately was traced to network switches that directed network traffic over a highly overburdened and fragile network that was further taxed when a researcher uploaded a multigigabyte file into the picture archiving and communication system (PACS). The failure resulted in a four-hour closure of the emergency room, a complete shutdown of the network, and two days of paper-based clinical operations—a true "retro" experience for many of the physicians who had never practiced without computers. Network services were not fully recovered until six days after the onset of the disaster. Through this experience, CareGroup learned a valuable lesson about the importance of assessing and mitigating risk to the confidentiality, integrity, and availability of critical systems and information—and what to do when disaster strikes.

4. One might surmise that today the risk of overloading networks might be mitigated by migrating systems to the cloud
    a. Where storage and infrastructure resources are made available upon demand
    b. And services are provided in accordance with negotiated service-level agreements (SLAs)
5. However, today's cloud environments are equally susceptible to outages
6. Even the largest global cloud computing infrastructures can be brought down by seemingly minor factors—in some cases factors intended to provide security

Teaching Tip
Provide the example, one such example is a major crash of Microsoft's Azure Cloud that occurred in February 2013, when a secure socket layer (SSL) certificate used to authenticate the identity of a server was allowed to expire. The outage brought down cloud storage for 12 hours and affected secure Web traffic worldwide. Over 50 different Microsoft services reported performance problems during the outage.

7. Identity theft is a felonious and seriously disruptive invasion of personal privacy that also can cause physical harm

Teaching Tip
Provide the example, in 2006, a 27-year-old mother of four children in Salt Lake City received a phone call from a Utah social worker notifying her that her newborn had tested positive for methamphetamines and that the state planned to remove all of her children from her home. The young mother had not been pregnant in more than two years, but her stolen driver's license had ended up in the hands of a meth user who gave birth using the stolen identity. After a few tense days of urgent phone calls with child protective services, the victim was allowed to keep her children. She hired an attorney to sort out the damages to her legal and medical records. Months later, when she needed treatment for a kidney infection, she carefully avoided the hospital where her stolen identity had been used. But her caution did no good—her electronic record, with the identity thief's medical information intermingled, had circulated to hospitals throughout the community. The hospital worked with the victim to correct her charts to avoid making life-critical decisions based on erroneous information. The data corruption damage could have been far worse had the thief's baby not tested positive for methamphetamines, bringing the theft to the victim's attention.

8. One's personal genome is the most uniquely identifying of health information
9. It contains information not only about the individual, but about parents and siblings

Teaching Tip
Provide the following example, one determined and industrious 15-year-old used his own personal genome to find his mother's anonymous sperm donor. Even whole genome sequences that claim to be "anonymized" can disclose an individual's identity, as demonstrated by a research team at Whitehead Institute for Biomedical Research.

10. As genomic data are integrated into EHRs and routinely used in clinical care, the potential for damage from unauthorized disclosure and identity theft significantly increases
11. Malware

Teaching Tip

Provide the following as examples regarding malware. In July 2009, after noting several instances of computer malware affecting the United Kingdom's National Health Service (NHS) hospitals, a British news broadcasting station conducted a survey of the NHS trusts throughout England to determine how many of their systems had been infected by malware. Seventy-five percent replied, reporting that over 8,000 viruses had penetrated their security systems, with 12 incidents affecting clinical departments, putting patient care at risk, and exposing personal information. One Scottish trust was attacked by the Conficker virus, which shut down computers for two days. Some attacks were used to steal personal information, and at a cancer center, 51 appointments and radiotherapy sessions had to be rescheduled. The survey seemed to have little effect in reducing the threat—less than a year later, NHS systems were victimized by the Qakbot data-stealing worm, which infected over a thousand computers and stole massive amounts of information.

12. For decades, organizations and individuals have known that they need to fortify their desktop computers and laptops to counter the threat of computer malware
13. However, as medical device manufacturers have integrated personal computer technology into medical devices, they have neglected to protect against malware threats

Teaching Tip

Provide the following example, the Department of Veterans Affairs (VA) reported that between 2009 and 2013, malware infected at least 327 medical devices in VA hospitals, including x-ray machines, lab equipment, equipment used to open blocked arteries, and cameras used in nuclear medicine studies. In one reported outbreak, the Conficker virus was detected in 104 devices in a single VA hospital. A VA security technologist surmised that the malware most likely was brought into the hospital on infected thumb drives used by vendor support technicians to install software updates.

14. Infections from malware commonly seen in the wild are most likely to cause a degradation of system performance or to expose patients' private data
15. Malware written to target a specific medical device could result in even more dire consequences
16. Recognizing the safety risk posed by malware, the Food and Drug Administration (FDA) in 2013 began warning device manufacturers that their devices were at risk of being infected by malware that could endanger patients
17. The FDA recommended that manufacturers seeking approval for their devices submit security plans to counter the malware threat, and that hospitals vigilantly report cyber security attacks
18. Since 2009, entities covered under the Health Insurance Portability and Accountability Act (HIPAA) have been required to notify individuals whose unsecured protected health information may have been exposed due to a security breach, and to report to the Department of Health and Human Services (HHS) breaches affecting 500 or more individuals
19. HHS maintains a public Web site, frequently referred to as the "wall of shame," listing the breaches reported

Teaching Tip

Provide the following example, between September 22, 2009, and January, 2014, a total of 804 breaches, affecting 29.3 million individuals, were reported! Seven breaches, each of which affected over a million individuals, accounted for over half of the individuals affected, and all were attributed to the loss or theft of equipment or media—the most visible and easily detected types of breaches. Thus, one might surmise that this accounting may be just the tip of the iceberg of electronic breaches of health information.

20. The bottom line is that systems, networks, and software applications, as well as the enterprises within which they are used, are highly complex, and the only safe assumption is that "things will go wrong."
21. Trustworthiness is an essential attribute for the systems, software, services, processes, and people used to manage individuals' personal health information and to help provide safe, high-quality healthcare

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

HIT Trust Framework

1. Trustworthiness can never be achieved by implementing a few policies and procedures, and some security technology
2. Requires a complete HIT trust framework
3. This trust framework comprises seven layers of protection
4. Each of which is dependent upon the layers below it
5. This trust framework does not dictate a physical architecture
6. The trust framework may be implemented within a single or across multiple sites, and may comprise enterprise, mobile, and cloud components
    a. Layer 1: Risk management
        (1) Risk management is the foundation of the HIT trust framework
        (2) Objective risk assessment informs decision making and positions the organization to correct those physical, operational, and technical deficiencies that pose the highest risk to the information assets within the enterprise
        (3) Objective risk assessment also puts into place protections that will enable the organization to manage the residual risk and liability
        (4) Patient safety, individual privacy, and information security all relate to *risk*
        (5) Risk is simply the probability that some "bad thing" will happen
        (6) Risk is always with respect to a given context comprising relevant threats, vulnerabilities, and valued assets
        (7) Threats can be natural occurrences (e.g., earthquake, hurricane), accidents, or malicious people and software programs

(8) Vulnerabilities are present in facilities, hardware, software, communication systems, business processes, workforces, and electronic data

(9) Valued assets can be anything from reputation to business infrastructure to information to human lives

(10) A security risk is the probability that a threat will exploit a vulnerability to expose confidential information, corrupt or destroy data, or interrupt or deny essential information services

(11) If that risk could result in the unauthorized disclosure of an individual's private health information or the compromise of an individual's identity, it also represents a privacy risk

(12) If the risk could result in the corruption of clinical data or an interruption in the availability of a safety-critical system, causing human harm or the loss of life, it is a safety risk as well

(13) Information security is widely viewed as the protection of information confidentiality, data integrity, and service availability

(14) Indeed, these are the three areas directly addressed by the technical safeguards addressed in the Health Insurance Portability and Accountability Act (HIPAA) Security Rule

(15) Generally, safety is most closely associated with protective measures for data integrity and the availability of life-critical information and services

(16) Privacy is more often linked to confidentiality protection

(17) However, the unauthorized exposure of private health information, or corruption of one's personal electronic health record as a result of an identity theft, also can put an individual's health and safety at risk

(18) Risk management is an ongoing, individualized discipline wherein each individual or each organization examines its own threats, vulnerabilities, and valued assets and decides for itself how to deal with identified risks—whether to reduce or eliminate them, counter them with protective measures, or tolerate them and prepare for the consequences

(19) Risks to personal privacy, patient safety, care quality, financial stability, and public trust all must be considered in developing an overall strategy for managing risks both internal and external to an organization

(20) In bygone times, risk assessment focused on resources within a well-defined physical and electronic boundary that comprised the "enterprise"

(21) In today's environment, risk assessment is far more complex and will require careful analysis of potential data flows and close examination of service-level-agreements (SLAs) for enterprise and cloud services and data-sharing agreements with trading partners

b. Layer 2: Information Assurance Policy

(1) The risk management strategy will identify what risks need to be addressed through an information assurance policy that governs operations, information technology, and individual behavior

(2) The information assurance policy comprises rules that guide organizational decision-making and that define behavioral expectations and sanctions for unacceptable actions

(3) The policy defines rules for protecting individuals' private information, for securing all confidential information, and for providing choice and transparency with respect to how individuals' health information is used and shared

(4) It includes rules that protect human beings, including patients, employees, family members, and visitors, from physical harm that could result from data corruption or service interruption

(5) The information assurance policy defines the rules enforced to protect the organization's valued information assets from identified risks to confidentiality, data integrity, and service availability

(6) Some policy rules are mandated by applicable state and federal laws and regulations

Teaching Tip

Provide the following as an example, the HIPAA Security Rule requires compliance with a set of administrative, physical, and technical standards, and the HIPAA Privacy Rule sets forth privacy policies to be implemented. However, although the HIPAA regulations establish uniform minimum privacy and security standards, state health privacy laws are quite diverse. Because the HIPAA regulations apply only to "covered entities" and their "business associates" and not to everyone who may hold health information, and because the HIPAA regulations pre-empt only those state laws that are less stringent, the privacy protections of individuals and security protections of health information vary depending on who is holding the information and the state in which they are located.

(7) The policy that codifies the nurse's obligation to protect patients' privacy and safety is embodied in the ICN Code of Ethics for Nurses

  i. The nurse holds in confidence personal information and uses judgment in sharing this information

  ii. The nurse takes appropriate action to safeguard individuals whose care is endangered by a co-worker or any other person

(8) HIT information assurance policy provides the foundation for the development and implementation of physical, operational, architectural, and security technology safeguards

(9) Nursing professionals can provide valuable insights, recommendations, and advocacy in the formulation of information assurance policy within the organizations where they practice, as well as within their professional organizations and with state and federal governments

c. Layer 3: Physical Safeguards

(1) Physically safeguarding health information, and the information technology used to collect, store, retrieve, analyze, and exchange health data, is essential to assuring that information needed at the point and time of care is available, trustworthy, and usable in providing quality healthcare

- **(2)** The electronic signals that represent health information are not themselves "physical"
- **(3)** The facilities within which data are generated, stored, displayed, and used; the media on which data are recorded; the information system hardware used to process, access, and display the data; and the communications equipment used to transmit and route the data are
- **(4)** So are the people who generate, access, and use the information the data represent
- **(5)** Physical safeguards are essential to protecting these assets in accordance with the information assurance policy
- **(6)** The HIPAA Security Rule prescribes four standards for physically safeguarding electronic health information protected under HIPAA
  - **i.** Facility-access controls
  - **ii.** Workstation-use policies and procedures
  - **iii.** Workstation-security measures
  - **iv.** Device and media controls
- **(7)** Physically safeguarding the lives and well-being of patients is central to the roles and responsibilities of nurses
- **(8)** Protecting patients require the physical protection of
  - **i.** The media on which their health data are recorded
  - **ii.** As well as the devices, systems, networks
  - **iii.** Facilities involved in data collection, use, storage, and disposal
- **(9)** Healthcare organizations are increasingly choosing to purchase services from third parties, rather than hosting and maintaining these services within their own facilities
- **(10)** Third-party services include
  - **i.** EHR software-as-a-service (SaaS) applications
  - **ii.** Outsourced hosting services
  - **iii.** Cloud storage
  - **iv.** Infrastructure offerings
- **(11)** The HIPAA Security Rule requires that the providers of these services sign a business associate agreement in which they agree to meet all of the HIPAA security standards
- **(12)** If a breach occurs, the covered entity retains primary responsibility for reporting and responding to the breach
- **(13)** It is essential that healthcare entities perform due diligence to assure that their business associates understand and are capable of providing the required levels of physical protection and data isolation

d. Layer 4: Operational Safeguards

- **(1)** Operational safeguards are
  - **i.** Processes
  - **ii.** Procedures
  - **iii.** Practices that govern the creation, handling, usage, and sharing of health information in accordance with the information assurance policy
- **(2)** The HIT trust framework includes the following operational safeguards:
  - **i.** Security operations management
    - HIPAA regulations require that each healthcare organization designate a "security official" and a "privacy official" to be responsible for developing and implementing security and privacy policies and procedures
    - The management of services relating to the protection of health information and patient privacy touches every function within a healthcare organization
  - **ii.** Awareness and training
    - One of the most valuable actions a healthcare organization can take to maintain public trust is to inculcate a culture of safety, privacy, and security
    - If every person employed by, or associated with, an organization feels individually responsible for protecting the
      - Confidentiality
      - Integrity
      - Availability of health information
      - Privacy and safety of patients
      - Risk for that organization will be vastly reduced!
    - Recognition of the value of workforce training is reflected in the fact that the HIPAA Security and Privacy Rules require training in security and privacy, respectively, for all members of the workforce
    - Formal privacy and security training should be required to be completed at least annually, augmented by simple and frequent reminders
  - **iii.** Business agreements
    - Business agreements
      - Help manage risk and bond liability
      - Clarify responsibilities and expectations
      - Define processes for addressing disputes among parties
    - The HIPAA Privacy and Security Rules require that each person or organization that provides to a covered entity services involving individually identifiable health information must sign a "business associate" contract obligating the service provider to comply with HIPAA requirements, subject to the same enforcement and sanctions as covered entities
    - Business associates include entities that provide services delivered within the
      - Covered entity's own premises
      - Entities that provide health-information-exchange services
      - Entities that provide services in the "cloud"

- The HIPAA Privacy Rule also requires “data use agreements” defining how “limited data sets” will be used
- Organizations wishing to exchange health information as part of the National eHealth Collaborative must sign a Data Use and Reciprocal Support Agreement (DURSA) in which they agree to exchange and use message content only in accordance with the agreed upon provisions
- Agreements are only as trustworthy as the entities that sign them
- Organizations should exercise due diligence in deciding with whom they will enter into business agreements

iv. Configuration management

- Configuration management refers to processes and procedures for maintaining an accurate and consistent accounting of the physical and functional attributes of a system throughout its life cycle
- From an information assurance perspective, configuration management is the process of controlling and documenting modifications to the
    - Hardware
    - Firmware
    - Software
    - Documentation involved in the protection of information assets

v. Identity management and authorization

- Arguably the operational processes most critical to the effectiveness of technical safeguards are the process used to positively establish the identity of the individuals and entities to whom rights and privileges are being assigned, and the process used to assign authorizations to those identities
- Many of the technical safeguards (e.g., authentication, access control, audit, digital signature) rely upon and assume the accuracy of an identity that is established when an account is created
- Identity management begins with verification of the identity of each individual before creating a system account
- This process, called “identity proofing,” may require the person to present one or more government-issued documents containing the individual’s photograph, such as a driver license or passport
- Once identity has been positively established, one or more system accounts are created, giving the individual the access rights and privileges essential to performing his assigned duties, and a means of “authenticating” this identity when the individual attempts to access resources is assigned
- The life cycle of identity management includes the prompt termination of identities and authorizations when the individual leaves the organization or otherwise no longer needs the resources and privileges assigned to him, as well as ongoing the maintenance of the governance processes that support this life cycle

vi. Consent management

- Obtaining an individual’s consent prior to taking any actions that involve her physical body or personal information is fundamental to respecting her right to privacy, and a profusion of state and federal laws set forth requirements for protecting and enforcing this right
- Medical ethics and state laws require that providers obtain a patient’s “informed consent” before delivering medical care, or administering diagnostic tests or treatment
- The Common Rule, designed to protect human research subjects, requires informed consent before using an individual or her biological materials in research
- The HIPAA Privacy Rule specifies conditions under which an individual’s personal health information may be used and exchanged, including uses and exchanges that require the individual’s express “authorization”
- Certain types of information, such as psychotherapy notes and substance abuse records, have special restrictions and authorization requirements
- Managing an individual’s consents and authorizations and assuring consistent adherence to the individual’s privacy preferences are a complex process, but essential to protecting personal privacy
- Today, consent management is primarily a manual process, and consents are collected and managed within a single institution
- However, as access to health information and biological specimens is shared among multiple institutions, consent management becomes much more complex
- At the same time, the risk to personal privacy is heightened
- New standards and models for electronically capturing and exchanging individual permissions, and for “segmenting” data for special protection, are beginning to emerge

vii. System activity review

- One of the most effective means of detecting potential misuse and abuse of privileges is by regularly reviewing records of information system activity, such as audit logs, facility access reports, security incident tracking reports, and accountings of disclosures
- The HIPAA Privacy Rule requires that covered entities provide to patients, upon request, an accounting of all disclosures (i.e., outside the entity holding the information) of their protected health information except for those

disclosures for purposes of treatment, payment, and healthcare operations (TPO)

- The HITECH Act dropped the TPO exception; as of this writing, regulation to implement this requirement is still in development
- Although technology to automate system-activity review exists, many healthcare organizations still rely on manual review of audit logs to detect potential intrusions and misuse
- As more clinical data are generated and exchanged, the sheer volume will overpower system-activity review as a manual operation
- Further, the HITECH Act's requirement to include TPO in an accounting of disclosures will necessitate the use of automated review

viii. Continuity of operations

- Unexpected events, both natural and human-produced, do happen, and when they do, it is important that critical health services can continue to be provided
- As healthcare organizations become increasingly dependent on electronic health information and information systems, the need to plan for unexpected events, and to develop operational procedures that will enable the organization to continue to function, becomes more urgent
- The HIPAA Security Rule requires that organizations establish and implement policies and procedures for responding to an emergency
- Contingency planning is part of an organization's risk-management strategy, and the first step is performed as part of a risk assessment — identifying those software applications and data that are essential for enabling operations to continue under emergency conditions and for returning to full operations
- These business-critical systems are those to which architectural safeguards such as fail-safe design, redundancy and failover, and availability engineering should be applied

ix. Incident procedures

- Awareness and training should include a clear explanation of what an individual should do if she suspects a security incident, such as a malicious code infiltration or denial-of-service attack or a breach of confidential information
- Organizations need to plan their response to an incident report, including procedures for investigating and resolving the incident, notifying individuals whose health information may have been exposed as a result of the incident, and penalizing parties responsible for the incident
- Individuals whose information may have been exposed as a result of a breach must be notified, and breaches affecting 500 or more individuals must be reported to the Department of Health and Human Services
- Not all security incidents are major or require enterprise-wide response
- Some incidents may be as simple as a user accidentally including PHI in a request sent to the help desk
- Incident procedures should not require a user or help-desk operator to make a judgment call on the seriousness of a disclosure; procedures should clearly specify what an individual should do when she notices a potential security incident

x. Sanctions

- The HIPAA law, as amended by the HITECH Act, prescribes severe civil and criminal penalties for sanctioning entities that fail to comply with the privacy and security provisions
- Organizations must implement appropriate sanctions to penalize workforce members who fail to comply with privacy and security policies and procedures

xi. Evaluation

- Periodic, objective evaluation of the operational and technical safeguards in place helps measure the effectiveness, or "outcomes," of the security management program
- A formal evaluation should be conducted at least annually and should involve independent participants who are not responsible for the program
- Security evaluation should include resources and services maintained within the enterprise, as well as resources and services provided by business associates—including SaaS and cloud-services providers
- Independent evaluators can be from either within or outside an organization, so long as they can be objective
- In addition to the annual programmed evaluation, security technology safeguards should be evaluated whenever changes in circumstances or events occur that affect the risk profile of the organization

e. Layer 5: Architectural Safeguards

(1) A system's architecture comprises its individual hardware and software components, the relationships among them, their relationship with the environment, and the principles that govern the system's design and evolution over time

(2) Specific architectural design principles, and the hardware and software components that support those principles, work together to establish the technical foundation for security technology safeguards

(3) In simpler times, the hardware and software components that comprised an enterprise's architecture were under the physical and logical control of the enterprise itself

(4) In an era when an enterprise may depend upon external providers of enterprise services (e.g., a health exchange service, hosting service, backup service), and virtualized services (e.g., SaaS, cloud resources), this may not be the case

(5) Still, the design principles discussed below apply whether an enterprise's architecture is centralized or distributed, physical or virtual

i. Scalability

- As more health information is recorded, stored, used, and exchanged electronically, systems and networks must be able to deal with that growth
- The catastrophic failure at CareGroup resulted from the network's inability to scale to the capacity required
- The most recent stage in the evolution of the Internet specifically addresses the scalability issue by virtualizing computing resources into services, including software as a service (SaaS), platforms as a service (PaaS), and infrastructure as a service (IaaS)—collectively referred to as "cloud" services
- Indeed, the Internet itself was created on the same principle as cloud computing —the creation of a virtual, ubiquitous, continuously expanding network through the sharing of resources (servers) owned by different entities
- Whenever one sends information over the Internet, the information is broken into small packets that are then sent ("hop") from server to server from source to destination, with all of the servers in between being "public"—in the sense that they probably belong to someone other than the sender or the receiver
- Cloud computing, a model for providing "on demand" computing services accessible over the Internet, pushes virtualization to a new level by sharing applications, storage, and computing power to offer scalability beyond what would be economically possible otherwise

ii. Reliability

- Reliability is the ability of a system or component to perform its specified functions consistently, over a specified period of time—an essential attribute of trustworthiness
- Security- and safety-critical system components should be engaged and integrated so that no single point of failure exists
- If a given component fails, the system should engage a second, backup component with no breach of sensitive information, interruption of operations, or corruption of data

iii. Safety

- Safety-critical components, software, and systems should be designed so that if they fail, the failure will not cause people to be physically harmed
- Note that fail-safe design may indicate that, under certain circumstances, a component should be shut down, or forced to violate its functional specification, to avoid harming someone
- So the interrelationships among redundancy and failover, reliability, and fail-safe design are complex, yet critical to patient safety
- The "break-the-glass" feature that enables an unauthorized user to gain access to patient information in an emergency situation is an example of fail-safe design
- If, in an emergency, an EHR system "fails" to provide a nurse access to the clinical information he needs to deliver care, the "break-the-glass" feature will enable the system to "fail safely"
- Fail-safe methods are particularly important in research where new treatment protocols and devices are being tested for safety

iv. Interoperability

- Interoperability is the ability of systems and system components to work together
- To exchange health information effectively, healthcare systems must interoperate not only at the technical level, but also at the syntactic and semantic levels
- The Internet and its protocols, which have been adopted for use both within and between enterprises, package and transmit data in small packets (electronic bits) over a network in such a way that upon arrival at their destination the data appear the same as when they were sent
- If the data are encrypted, the receiving system must be able to decrypt the data, and if the data are wrapped in an electronic envelope (e.g., electronic mail message, HL7 message), the system must open the envelope and extract the content
- Finally, the system must translate the electronic data into health information that the system's applications and users will understand
- Open standards, including encryption and messaging standards, and standard vocabulary for coding and exchanging security attributes and patient permissions —e.g., Security Assertion Markup Language [SAML], eXtensible Access Control Markup Language [XACML]—are fundamental to implementing interoperable healthcare systems

v. Availability

- Required services and information must be available and usable when they are needed
- Availability is measured as the proportion of time a system is in a functioning condition
- A reciprocal dependency exists between security technology safeguards and high-availability design—security safeguards depend upon the availability of systems, networks, and information, which in turn enable those safeguards to protect enterprise assets against threats to availability, such as denial-of-service attacks

- Resource virtualization and "cloud" computing are important technologies for helping assure availability

vi. Simplicity

- Safe, secure architectures are designed to minimize complexity
- The simplest design and integration strategy will be the easiest to understand, to maintain, and to recover in the case of a failure or disaster

vii. Process isolation

- Process isolation refers to the extent to which processes running on the same system at different trust levels, virtual machines (VMs) running on the same hardware, or applications running on the same computer or tablet are kept separate
- Isolation is important to ensuring that if one process, VM, or application misbehaves or is compromised, other processes, VMs, or applications can continue to operate safely and securely
- Process isolation is particularly important to preserve the integrity of the operating system itself
- The operating system is the most critical component in a system because it is responsible for managing, protecting, and provisioning all system resources (e.g., data files, directories, memory, application processes, network ports)
- Within today's operating systems, processes critical to the security and reliability of the system execute within a protected hardware state, while untrusted applications execute within a separate state
- However, this hardware architectural isolation is undermined if the system is configured so that untrusted applications are allowed to run with privilege, which puts the operating system itself at risk

Teaching Tip

Use the following as an example, if a user logs into an account with administrative privileges and then runs an application that has been infected by a virus (or opens an infected e-mail attachment), the entire operating system may become infected.

- Within a cloud environment, the hypervisor is assigned responsibility for assuring that VMs are kept separate so that processes running on one subscriber's VM cannot interfere with those running on another subscriber's VM
- In general, the same security safeguards used to protect an enterprise system are equally effective in a cloud environment—but only if the hypervisor is able to maintain isolation among virtual environments
- Another example of isolation is seen in the Apple iOS environment
- Apps running on an iPad or iPhone are isolated such that not only are they unable to view or modify each other's data, but one app does not even know whether another app is installed on the device
- Apple calls this architectural feature "sandboxing"

f. Layer 6: Security Technology Safeguards

(1) Security technology safeguards are software and hardware services specifically designed to perform security-related functions

i. Person and entity authentication

- The identity of each entity, whether it be a person or a software entity, must be clearly established before that entity is allowed to access protected systems, applications, and data
- Identity management and authorization processes are used to validate identities and to assign them system rights and privileges (see Identity Management and Authorization above)
- Then, whenever the person or application requires access, it asserts an identity (userID) and authenticates that identity by providing some "proof" in the form of something it has (e.g., smartcard), something it knows (e.g., password, private encryption key), or something it is (e.g., fingerprint)
- The system then checks to verify that the userID represents someone who has been authorized to access the system, and then verifies that the "proof" provided provides the evidence required
- While only people can authenticate themselves using biometrics, both people and software applications can authenticate themselves using public–private key exchanges

Teaching Tip

Provide the following example, individuals who work for federal agencies, such as the Department of Veterans Affairs (VA), are issued Personal Identity Verification (PIV) cards containing a digital certificate that uniquely identifies the individual and the rights assigned to him. The National Strategy for Trusted Identities in Cyberspace (NSTIC) program is working toward an "identity ecosystem" in which each individual possesses trusted credentials for proving her identity.

ii. Access control

- Access-control services help assure that people, computer systems, and software applications are able to use all of and only the resources (e.g., computers, networks, applications, services, data files, information) that they are authorized to use and only within the constraints of the authorization
- Access controls protect against unauthorized use, disclosure, modification, and destruction of resources, and unauthorized execution of system functions

- Access-control rules are based on federal and state laws and regulations, the enterprise's information assurance policy, as well as consumer-elected preferences
- These rules may be based on the user's identity, the user's role, the context of the request (e.g., location, time of day), and/or a combination of the sensitivity attributes of the data and the user's authorizations

iii. Audit controls

- Security audit controls collect and record information about security-relevant events within a system component or across a network
- Audit logs are generated by multiple software components within a system, including operating systems, servers, firewalls, applications, and database management systems
- Many healthcare organizations manually review these logs to detect potential intrusions and misuse
- Automated intrusion and misuse detection tools are increasingly being used to normalize and analyze data from network monitoring logs, system audit logs, application audit logs, and database audit logs to detect potential intrusions originating from outside the enterprise, and potential misuse by authorized users within an organization

iv. Data integrity

- Data integrity services provide assurance that electronic data have not been modified or destroyed except as authorized
- Cryptographic hash functions are commonly used for this purpose
- A cryptographic hash function is a mathematical algorithm that uses a block of data as input to generate a "hash value" such that any change to the data will change the hash value that represents it—thus detecting an integrity breach

v. Non-repudiation

- Sometimes the need arises to assure not only that data have not been modified inappropriately, but also that the data are in fact from an authentic source
- This proof of the authenticity of data is often referred to as "non-repudiation" and can be met through the use of digital signatures. Digital signatures use public-key (asymmetric) encryption to encrypt a block of data using the signer's private key
- To authenticate that the data block was signed by the entity claimed, one only needs to try decrypting the data using the signer's public key; if the data block decrypts successfully, its authenticity is assured

vi. Encryption

- Encryption is simply the process of obfuscating information by running the data representing that information through an algorithm (sometimes called a "cipher") to make it unreadable until the data are decrypted by someone possessing the proper encryption "key"
- "Symmetric" encryption uses the same key to both encrypt and decrypt data, while "asymmetric" encryption (also known as "public-key encryption") uses two keys that are mathematically related such that one key is used for encryption and the other for decryption
- One key is called a "private" key and is held secret; the other is called a "public key" and is openly published
- Which key is used for encryption and which for decryption depends upon the assurance objective

Teaching Tip

Provide the following, for example, secure e-mail encrypts the message contents using the recipient's public key so that only a recipient holding the private key can decrypt and view it, then digitally signs the message using the sender's own private key so that if the recipient can use the sender's public key to decrypt the signature, thus being assured that the sender actually sent it. Encryption technology can be used to encrypt both data at rest and data in motion. So it is used both to protect electronic transmissions over networks and to protect sensitive data in storage.

vii. Malicious software protection

- Malicious software, also called "malware," is any software program designed to infiltrate a system without the user's permission, with the intent to damage or disrupt operations, or to use resources to which the miscreant is not authorized access
- Malicious software includes programs commonly called viruses, worms, Trojan Horses, and spyware
- Protecting against malicious software requires not only technical solutions to prevent, detect, and remove these invasive pests, but also policies and procedures for reporting suspected attacks

vii. Transmission security

- Sensitive and safety-critical electronic data that are transmitted over vulnerable networks, such as the Internet, must be protected against unauthorized disclosure and modification
- The Internet protocol provides no protection against the disclosure or modification of any transmissions, and no assurance of the identity of any transmitters or receivers (or eavesdroppers)
- Protecting network transmissions between two entities (people, organizations, or software programs) requires that the communicating entities authenticate themselves to each other, confirm data integrity using something like a

cryptographic hash function, and encrypt the channel over which data are to be exchanged

- Both the Transport Layer Security (TLS) protocol and Internet Protocol security (IPsec) protocol suites support these functions, but at different layers in the Open System Interconnection (OSI) model
- TLS establishes protected channels at the OSI transport layer (layer 4), allowing software applications to exchange information securely

Teaching Tip

Provide the following, for example, TLS might be used to establish a secure link between a user's browser and a merchant's check-out application on the Web. IPsec establishes protected channels at the OSI network layer (layer 3), allowing Internet gateways to exchange information securely.

For example, IPsec might be used to establish a virtual private network (VPN) that allows all hospitals within an integrated delivery system to openly yet securely exchange information. Because IPsec is implemented at the network layer, it is less vulnerable to malicious software applications than TLS and also less visible to users (e.g., IPsec does not display an icon in a browser).

g. Layer 7: Usability Features

(1) The top layer of the trust framework includes services that make life easier for users

(2) "Single sign-on" often is referred to as a security "service," but in fact it is a usability service that makes authentication services more palatable

(3) Both single sign-on and identity federation enable a user to authenticate herself once and then to access multiple applications, multiple databases, and even multiple enterprises for which she is authorized, without having to re-authenticate herself

(4) Single sign-on enables a user to navigate among authorized applications and resources within a single organization

(5) Identity federation enables a user to navigate between services managed by different organizations

(6) Both single sign-on and identity federation require the exchange of "security assertions"

(7) Once the user has logged into a system, that system can pass the user's identity, along with other attributes, such as role, method of authentication, and time of login, to another entity using a security assertion

(8) The receiving entity then enforces its own access-control rules, based on the identity passed to it

(9) Neither single sign-on nor identity federation actually adds security protections (other than to reduce the need for users to post their passwords to their computer monitors)

(10) In fact, if the original identity-proofing process or authentication method is weak, the risk associated with that weakness will be propagated to any other entities to which the identity is passed

(11) Therefore, whenever single sign-on or federated identity is implemented, a key consideration is the level-of-assurance provided by the methods used to identity-proof and authenticate the individual

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY AND CONCLUSIONS

- Healthcare is in the midst of a dramatic and exciting transformation that will enable individual health information to be captured, used, and exchanged electronically using interoperable HIT
- The potential impacts on individuals' health and on the health of entire populations are dramatic
- Outcomes-based decision support will help improve the safety and quality of healthcare
- The availability of huge quantities of de-identified health information will help scientists discover the underlying genetic bases for diseases, leading to earlier and more accurate detection and diagnoses, more targeted and effective treatments, and ultimately personalized medicine
- In this chapter we have explained the critical role that trustworthiness plays in HIT adoption and in providing safe, private, high-quality care
- We have introduced and described a trust framework comprising seven layers of protection essential for establishing and maintaining trust in a healthcare enterprise
- Many of the safeguards included in the trust framework have been codified in HIPAA standards and implementation specifications
- Building trustworthiness in HIT always begins with objective risk assessment, a continuous process that serves as the basis for developing and implementing a sound information assurance policy and physical, operational, architectural, and technological safeguards to mitigate and manage risks to patient safety, individual privacy, care quality, financial stability, and public trust

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Explain the critical role that "trustworthiness" plays in healthcare quality and safety
- Explain the relationship among security, privacy, and trust
- Propose adherence to fair information practices principles as essential to privacy and trust
- Introduce and describe a trust framework comprising seven layers of protection essential for protecting sensitive and safety-critical health information and services

Teaching Tip

Ask the students to define the keywords

- Health information technology
- Trustworthy systems
- Security
- Privacy
- Fair information practices principles

CHAPTER REVIEW QUESTIONS

Question 10.1: What is the purpose of the Code of Ethics for nurses?

a. To promote, advocate for, and strive to protect health, safety, and rights of the patient
b. To guide staffing measures by nursing administration
c. To integrate in the design of the computer architecture
d. To guide the development of Meaningful Use

Question 10.2: Which describes the major differences between security and privacy?

a. Security and privacy are synonymous
b. Privacy and security require secure hardware
c. Privacy is more than security and security is more than privacy
d. Privacy and security deal with patient history

Question 10.3: Which of the following provide the principles intended to guide the actions of all people and entities that participate in networked, electronic exchange of individually identifiable health information?

a. Rights of individuals to secrecy and selected transparency in the collection and use of their health information
b. Rights of individuals to openness, transparency, fairness, and choice in the collection and use of their health information
c. Rights of individuals to privacy and security in the collection and use of their health information
d. Rights of individuals to review and approve the collection and use of their health information

Question 10.4: Which statement best describes a HIT Trust Framework?

a. HIT comprises of one layer of trustworthiness that serves as its foundation True ___ False ___
b. HIT has an assessment that serves as an operational Information Assurance Policy True ___ False ___
c. HIT comprises of seven layers of protection each dependent upon the layers below True ___ False ___
d. HIT trustworthiness is achieved by implementing a few policies and procedures and some security technology True ___ False ___
e. HIT framework for achieving trustworthiness requires the collection of health information from patients True ___ False ___

Question 10.5: Which best describes Layer 1 of the HIT Trust Framework—Risk Management?

a. A Risk that places protection on the organization to manage residual Risk and liability
b. A Risk the describes system safety and quality measures
c. A Risk that supports the hardware and software design
d. A Risk that addressed threats that will expose confidential information

Question 10.6: What are the four HIPAA Security Rule standards for Physical Safeguards of electronic health information?

a. Work-security Measures, Device and Media Controls, System Activity Review, and Facility Access Controls
b. Facility Access Controls, Workstation-use Policies and Procedures, Workstation-security Measures, and Device and Media Controls
c. Workstation-use Policies and Procedures, Device and Media Controls, System Activity Review, and Work-security measures
d. System Activity Review, Facility Access Controls, Device and Media Controls, and Physical Safeguarding of Patients

Question 10.7: The operational safeguards identified for the HIT Trust Framework address the processes, procedures, and practices that govern the creation, handling, usage, and sharing of the health information. Specifically which of the listed below are operational safeguards?

a. Business Agreements True ___ False ___
b. Configuration Management True ___ False ___
c. Patient Safety True ___ False ___
d. Incident Procedures True ___ False ___
e. Risk Management True ___ False ___

Question 10.8: What are at least four major design principles that govern the system's design and evolution over time highlighted in the Architectural Safeguards for the HIT Trust Framework?

a. Availability, Cloud Storage, Simplicity, and Process Isolation
b. Process Isolation, Safety, Cloud Storage, and Reliability
c. Interoperability, Availability, Reliability, and Cloud Storage
d. Scalability, Reliability, Safety, and Interoperability

Question 10.9: The Security Technology Safeguards are software and hardware services specifically designed to perform security-related functions. Identify which example standards are useful in implementing these safeguards?

a. Access Control, Data Integrity, Encryption, and Transmission Security
b. Transmission Security, ONC Interoperability, Access Control, and Data Integrity
c. Data Integrity, Access Control, Encryption, and Software Worms
d. Audit Controls, Data Integrity, Standardized IEEE IT Features, and Access Control

Question 10.10: The Usability Features in the top Layer 7 of the HIT Trust Framework includes services designed to make life easier for users. The major users focus on single sign-in and identity federation. What are the features of their authentication services?

a. Access multiple enterprises, trustworthiness, access multiple databases, and identify proof and authenticate the individual

b. Access multiple databases, access multiple enterprises, exchange of security assertions, and identify proof and authenticate the individual

c. Trustworthiness, exchange of security assertions, access multiple enterprises, and identify proof and authenticate the individual

d. Identify proof and authenticate the individual, trustworthiness, access multiple enterprises, and exchange of security assertions

ANSWERS AND EXPLANATIONS

Question 10.1: (a) To promote, advocate for, and strive to protect health, safety, and rights of the patient. The ANA's Code of Ethics for Nurses with Interpretive Statements (2001) includes a commitment "to promote, advocate for, and strive to protect the health, safety, and rights of the patient." The nursing profession is firmly grounded in a tradition of ethics, patient advocacy, care quality, and human safety. The registered nurse is well indoctrinated on clinical practice that respects personal privacy and that protects confidential information and life-critical information services.

Question 10.2: (c) Privacy is more than security and security is more than privacy. Many people think of "security" and "privacy" as synonymous. The concepts are indeed related in that security mechanisms can help protect personal privacy by assuring the confidential personal information is accessible only by authorized individuals and entities. However, privacy is more than security and security is more that privacy. ONC developed a Nationwide Privacy and Security Framework for Electronic Exchange of Individually Identifiable Health Information which identified eight principles intended to guide the actions of all people and entities that participate in networked, electronic exchange of individually identifiable health information.

Question 10.3: (b) Rights of individuals to openness, transparency, fairness, and choice in the collection and use of their health information. The ONC developed the document described in the previous answer and identified eight principles intended to guide the actions of all people and entities that participate in networked, electronic exchange of individually identified health information. These principles articulate the "rights" of individuals to openness, transparency, fairness, and choice in the collection and use of their health information. Although privacy has to do with information, security deals with protection.

Question 10.4:

a. False

b. True

c. True

d. False

e. False

The HIT Trust Framework comprises of several layers of protection, each of which is dependent upon the layers below it; all of which must work together to provide a trustworthy HIT environment for healthcare delivery.

Question 10.5: (a) A Risk that places protection on the organization to manage residual Risk and liability. Risk management is the foundation of the HIT Trust Framework. Objective Risk Assessment informs decision making and positions the organization to correct those physical, operational, and technical deficiencies that pose the highest risk to the information assets within the enterprise.

Question 10.6: (b) Facility Access Controls, Workstation-use Policies and Procedures, Workstation-Security Measures, and Device and Media Controls. Physical safeguards of health information and information technology used to collect, store, retrieve, analyze, and exchange health data are essential to assure that information needed at the point and time of care is available, trustworthy, and usable in providing quality healthcare. The HIPAA Security Rule prescribes four standards for physically safeguarding electronic health information protected under HIPAA: (1) facility-access controls, (2) workstation-use policies and procedures, (3) workstation-security measures, and (4) devices and medial controls.

Question 10.7:

a. True

b. True

c. False

d. True

e. False

Question 10.8: (d) Scalability, Reliability, Safety, and Interoperability.

A system's architecture comprises its individual hardware and software components, the relationships among them, their relationship with the environment, and the principles that govern the system's design and evolution over time. As shown in Figure 10.1, Layer 5, the specific design principles listed and the hardware and software components that support those principles work together to establish the technical foundation for security technology safeguards.

Question 10.9: (a) Access Control, Data Integrity, Encryption, and Transmission Security.

The safeguards are shown in Figure 10.1, Layer 6: Technical Safeguards, and Table 10.2, Security Technology Safeguards. They represent established standards developed by ANSI, ESTI, FIPS, NIST, HL7, IETF, ITU-T, and OASIS.

Question 10.10: (b) Access multiple databases, access multiple enterprises, exchange of security assertions, identify proof and authenticate the individual.

The top layer representing the Usability Features of the Trust Framework enables a user to authenticate herself once and then to access multiple enterprises for which she is authorized, without having to re-authenticate herself. Single sign-on enables a user to navigate between services managed by different organizations.

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PART 2

System Life Cycle

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11

System Life Cycle: A Framework

• OBJECTIVES

1. Describe a methodology and checklist for the phases of a system implementation life cycle.
2. Describe barriers and critical success factors related to implementation.
3. Describe the Nursing Informaticist role in a clinical system's implementation life cycle.
4. Discuss the heightened impact of regulatory and financial requirements on the Electronic Health Record (EHR).

• KEY WORDS

Project Scope
Request for Proposal (RFP)
Request for Information (RFI)
Workflow Analysis
Workplan
Feasibility Study
Go Live Plan
Communication Plan
Issue's List

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What makes a project successful? Worked on a successful project? What made the project successful? What stage of the project was easiest to complete? What stage was most difficult? Did you have a plan for completing the project?

For a WIIFM statement, say to the class, "The System Life Cycle (SLC) outlined in this chapter discusses the tasks multiple disciplines must accomplish to produce a technically sound, regulatory compliant and user friendly EHR supporting safe, effective and efficient patient care delivery. The SLC framework described by the American Nurses Credentialing Center's Nursing Informatics consists of four major phases. The chapter will further define these phases into the key tasks of a practical clinical systems implementation checklist and high-level workplan used successfully for real world implementations in the acute care setting. Many examples in this chapter refer to the implementation of an EHR; however, the framework, phases and tasks discussed can and should be applied to any clinical system or application implementation."

As a nurse, it is important to understand project management and the System Life Cycle.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

1. Overview
   a. Provide this introductory information, in the past, clinical systems implementation projects were considered successful when implemented on time and within budget
      (1) Later, the concepts of end-user perceptions determining project success in conjunction with streamlining clinician workflow layered clinical systems projects with additional success criteria
      (2) In the past 5 years, the focus for clinical systems implementations has been on systems improving patient safety through evidenced-based medicine while meeting the federal requirements set forth in the Health Information and Technology for Economic and Clinical Health
   b. As part of the HITECH Act, the Centers for Medicare and Medicaid Services (CMS), set forth a program providing organizations who demonstrate the meaningful use of an EHR to improve patient safety significant financial incentives
      (1) Today the successful system implementation project must be completed on-time, within budget, offer end-users streamlined workflow, with added safety in the delivery of healthcare and qualifying the organization for the financial benefits of meeting the meaningful use requirements

Teaching Tip

The System Life Cycle (SLC) outlined in this chapter discusses the tasks multiple disciplines must accomplish to produce a technically sound, regulatory compliant and user friendly EHR supporting safe, effective and efficient patient care delivery. The SLC framework described by the American Nurses Credentialing Center's Nursing Informatics consists of four major phases. The chapter will further define these phases into the key tasks of a practical clinical systems implementation checklist and high-level workplan used successfully for real world implementations in the acute care setting. Many examples in this chapter refer to the implementation of an EHR; however, the framework, phases and tasks discussed can and should be applied to any clinical system or application implementation.

Electronic Health Record

1. The Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting
2. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports
3. The EHR automates and streamlines the clinician's workflow
4. The EHR
   a. Has the ability to generate a complete record of a clinical patient encounter
   b. As well as support other care-related activities directly or indirectly via interface
5. The skills required to deliver direct patient care include the ability to understand and coordinate the work of multiple disciplines and departments
6. As multiple departments work in concert for optimum and safe patient care delivery
   a. The components of an EHR integrate data in a coordinated fashion to provide an organization's administration and clinicians demographic, financial, and clinical information
   b. The SLC provides a framework to attain a successful implementation

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Current Landscape

Teaching Tip

Provide this information, the US government has become one of the largest payers of healthcare. As the costs of healthcare increase, both the US population as well as the US government has become more critical of a payer-based health system. Four factors impacting healthcare payments and hospital information systems implementations are the evolution of evidence-based healthcare/medicine, the Federal Meaningful Use requirements set forth in the HITECH Act of 2009, the cost of technology, and the use of Project Management principles.

1. Evidence-based medicine (EBM)
   a. Both the Cochrane Collaboration and the Centre for Evidence-Based Medicine have adopted the definition of EBM as "... the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients"
   b. The purpose of EBM is to utilize scientific studies to determine the best course of treatment
   c. Functionality within the EHR provides access to the studies to understand the recommended treatment, while reviewing a patient's data in real time
2. Federal Initiative—HITECH Act 2009
   a. This act seeks to promote the meaningful use of information technology to improve patient safety in healthcare delivery
   b. The initiative requires an organization or provider to demonstrate consistent and appropriate use of information technology
   c. Adoption of the technology is required in stages, with increasing numbers of requirements in each stage
   d. Federal financial incentives are awarded to those meeting each stage
   e. Financial penalties will be levied against organization failing to meet the requirements by 2016
   f. The Meaningful Use requirements, leverage the results published in studies indicating a marked increase in patient

safety when specified functions of an information system are utilized

- **g.** Standardized terminology criteria permitting comparison of healthcare treatments and outcomes across healthcare facilities are incorporated into the later HITECH Act's stages
- **h.** Legislative and legal aspects of informatics are discussed in another chapter

3. Technology: Cost, benefit, and risk

- **a.** Technology costs are high, increasing the risk of significant financial losses from a poor implementation
- **b.** Vendors deliver the same software to clients
- **c.** The success of an information system project often rests on a well-planned and well-executed implementation
- **d.** A well-planned implementation dovetails an organization's strategic goals and culture
  - **(1)** With the introduction of and the ability to assimilate technology
  - **(2)** And workflow changes into the daily practice of healthcare delivery
- **e.** The SLC provides a structured implementation approach to accomplish this
- **f.** Healthcare information systems implementation time lines are often long
  - **(1)** Spanning 10–16 months for a full hospital information system implementation
- **g.** Increasing a project's risk level
  - **(1)** A technology generation, now only 6–8 months in length
  - **(2)** Can render partial obsolescence of a system by one technology generation before the first productive use of a system is sometimes obtained
- **h.** A well-planned and well-executed implementation provides a high level of risk mitigation and cost containment
- **i.** It is important to remember
  - **(1)** Technology is not the best solution to every problem
  - **(2)** Failure to recognize the problems causes inefficient processes from an information system problem
  - **(3)** Contributes to the risk and potential costs of a system

4. Project Management

- **a.** With roots in the construction industry, a significant body of knowledge in the area of planning and tracking large scale projects has evolved
- **b.** The Project Management Institute (PMI) has become the central and certifying organization for project management professional
- **c.** The Project Management Plan (PMP) developed through their efforts has migrated to the Information Technology (IT) area and is commonly called a project workplan
  - **(1)** It is the main planning document for an IT project
  - **(2)** And describes how major aspects of the project will be executed and managed
  - **(3)** The workplan is a living document
  - **(4)** Updated continuously throughout the project

Teaching Tip
Use the example, nurses have the ability to coordinate and manage multiple diverse care situations; this affords them strong skills to manage complex projects using a Project Workplan as a primary tool.

- **d.** See also the chapter devoted to Project Management
- **e.** A second essential tool for clinical implementations is the project's "issues list"
  - **(1)** As concerns, unusual situations, special education/training needs, programming errors, sequencing concerns impacting workflow, and new regulations are uncovered, they are placed on the issue's list
  - **(2)** Issues are added to the list and prioritized in relation to other issues and to the project goals and given a status
  - **(3)** Examples of issue statuses are open, in progress, testing, and closed
  - **(4)** The progress of an issue is tracked by the team on a regular basis with short progress notes added to the issue
  - **(5)** When a resolution is reached, the resolution is documented in the issues list and the status is updated
  - **(6)** The resolution documentation detail helps to eliminate the need for the team to revisit the decision
- **f.** Suggested data elements in an issue's list are
  - **(1)** Issue number
  - **(2)** Status
  - **(3)** Date added to the list
  - **(4)** Person identifying the problem/adding it to the list
  - **(5)** Module/application involved
  - **(6)** Description of the problem/issue
  - **(7)** Type of problem (e.g., programmatic, training, process, hardware, network)
  - **(8)** Note date
  - **(9)** Notes (e.g., work/efforts to resolve issue)
  - **(10)** Responsible party
  - **(11)** Resolution date
  - **(12)** Resolution Description

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SYSTEM LIFE CYCLE

Overview

1. The System Life Cycle is defined by the major components of

- **a.** Planning
- **b.** Analysis
- **c.** Design/Develop/Customize
- **d.** Implement/Evaluate/Maintain/Support

2. While this chapter discusses phases of the SLC related to an EHR implementation in an acute care setting
    a. It is applicable to many healthcare settings and projects
3. To continue to meet new regulatory and professional standards, EHRs and software applications must be continuously updated and upgraded in the Maintenance Phase
4. Regardless of the size or type of system, any EHR or single application implementation or upgrade project should address each of the items on the clinical system implementation checklist below
5. Not every project will require interfacing or data conversion or the addition of new devices, review of the checklist's steps will assure essential considerations are not overlooked

Teaching Tip
Refer to Figure 11.1.

6. The SLC phases use a problem-solving, scientific approach
    a. Problem solving begins with observation and understanding of the operations of the current systems or processes, sometimes referred to as the "Current State"
    b. The second step requires an in-depth assessment and definition of the new system's requirements; defining the "Future State"
    c. Designing, developing, and customizing a plan to meet requirements are addressed in the third phase
    d. The last phase, implementing, evaluating, supporting and ongoing maintenance, assures the system is sustainable after implementation

Teaching Tip
Use the example, nurses' daily use of the Nursing Process, a problem solving methodology, underlies the successes nurses have achieved in clinical informatics.

7. Countless iterations of the problem-solving methodology are used during the implementation and updating/upgrading of software
8. Inherent in the implementation process
    a. Is the need to recognize and manage change
    b. And its impact on patient care delivery and clinician work patterns/workflow
9. Finding a balance between the technical data capture criteria and the daily workflow of clinicians is required
10. As noted, vendors supply essentially the same software to clients at the time of purchase
11. The abilities of the project team members and organization to introduce and assimilate changes into daily practice can determine the success of a project
12. Literature focusing on the workflow impact of an EHR and the cultural impact to an organization are well documented by the Project Management Institute (PMI) and the Healthcare Information Management Systems Society (HIMSS)
13. The need to manage the change process is foundational to an EHR implementation if success is to be attained
14. Attempting to implement or upgrade a system without reviewing each of the checklist items within the SLC framework generally results in failure in one or more of the following areas
    a. EHR or application does not meet the stated goal of the project
    b. There is a failure to gain end-user acceptance
    c. Expenditures exceed budget
    d. Anticipated benefits are unrealized
15. In recent years the quality and abundance of online resources specific to clinical systems implementation has grown significantly
    a. Due in large part to the Federal HITECH meaningful use requirements
16. The Project Management Institute (PMI), and HIMSS, both offer training and certification processes specific to healthcare related project
17. The following online sites provide additional and supporting information
    a. www.pmi.org
    b. www.himss.org
    c. www.cms.gov/EHRincentivePrograms
    d. http://www.hhs.gov/ocio/eplc/Enterprise%20Performance%20Lifecycle%20Artifacts/eplc_artifacts.html
    e. www.hitechacthelp.com/2010/05/25/understanding-the-state-hie-toolkit/
    f. www.ahima.org/advocacy/rec/default.aspx
    g. www.healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov_home/1204

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Planning Phase

Teaching Tip
Provide the following information, the planning phase of the project begins once an organization has determined an existing requirement may be filled or solved by the development or implementation of an EHR or application. Establishing the committee framework to research and make recommendations for the project is an important first step.

The key documents created in the Planning Phase are:

- Project Governance Structure
- Gap Analysis
- Feasibility Study
- Project Scope Document
- Development of a high-level workplan and resource requirements

1. Governance structure and project staff
    a. The clinical leadership of an organization is highly involved in the establishment of an EHR committee structure
    b. The organization's strategic goals and priorities must be reviewed and considered
    c. The informatics nurse and information systems management team provide oversight
    d. However, committees work to develop the structure and participate to best guarantee the success of the project
    e. Assigning the appropriate resources, whether financial or personnel, is a critical success factor
    f. Recent evaluations of both successful and less than successful implementations have stressed the need to anticipate the impact of the new system on the culture of the organization and to take active steps to mitigate the effects of change on the organization
    g. The nursing informaticist often leads the assessment and documentation of the "Current State" and development of the desired "Future State"
    h. Cognizance of the new system's impact serves as a visible leader in the transition management efforts
2. Steering Committee
    a. Before an EHR is developed or selected, the organization must appoint an EHR steering committee
    b. The EHR steering committee, composed of internal and external stakeholders, is charged with providing oversight guidance to the selection and integration of the organization's strategic goals relative to the EHR requirements
    c. During the planning phase, the projected return on investment (ROI) is established
    d. The Steering Committee members' collective knowledge of the organization's daily operations provides global insight and administrative authority to resolve issues
    e. In most facilities, the Steering Committee has the ultimate authority for decision making

Teaching Tip
Refer to Figure 11.2.

3. Project team
    a. The project team is led by an appointed project manager
        (1) Often the Nurse Informaticist
        (2) And includes a designated team leader for each of the major departments affected by the system selection, implementation, or upgrade proposed
    b. The objectives of the project team are to
        (1) Understand the technology and technology restrictions of the proposed system
        (2) Understand the impact of intradepartmental EHR decisions
        (3) Make EHR decisions at the interdepartmental level
        (4) Become the key resource for their application
    c. A stated goal for the selection, implementation, or upgrading of an EHR is to improve patient safety and care
    d. Gains made by one department at the expense of another department rarely work to improve overall patient safety and care delivery
    e. The project team's ability to evaluate multiple departments' information requirements in light of the capabilities of the proposed system is integral to overall success
    f. Issues unable to be resolved by the Project Team are presented to the Steering Committee for resolution

Teaching Tip
Refer to Figure 11.3.

    g. The project manager is responsible for managing all aspects of the project; this includes
        (1) Software application development
        (2) Hardware and network acquisition/readiness
        (3) Oversight of the interface and conversion tasks
    h. The project manager must possess
        (1) Good communication
        (2) Facilitation
        (3) Organizational
        (4) And motivational skills when leading a successful implementation
    i. A sound knowledge of
        (1) Healthcare delivery
        (2) Regulatory requirements
        (3) Hospital culture, processes, and politics is essential
4. Departmental teams
    a. The charge of the departmental teams is
        (1) To thoroughly understand the department's information requirements and workflow
        (2) To gain a full understanding of the software's features and functions
        (3) To complete a gap analysis for the new system's capabilities with the department's requirements
        (4) To assist in the system testing effort
        (5) To participate in developing and conducting end-user education
        (6) To provide a high level of support during the initial activation period of the new system
    b. The team leaders must possess
        (1) A sound knowledge of the hospital and departmental policies and procedures (both formal and informal)
        (2) Good organizational and communication skills
        (3) And must be adept at gaining consensus and resolving conflict
    c. Team members may well change during the course of a 10–16 months implementation
    d. Hospital leaders, visionaries, and change agents participation must balance the pragmatic, bottom line dictated by organizational needs (e.g., meaningful use incentives vs. patient outcomes)

5. Develop project scope
   a. During the planning phase
      (1) The problem statement and goals of the implementation are defined
      (2) Committee structures established and the organization's requirements are defined for selecting, implementing, or upgrading an EHR or application
      (3) Including the implications for regulatory compliance for safe and quality clinical practice
   b. Commercial software developers and consultants rank this phase as the most critical factor in the selection of a system, even more important than the system itself
   c. Excellent planning takes time and thoughtful consideration
   d. Time spent in the developing a sound plan that encompasses all the checklist steps will reduce the amount of time spent in reworking areas not reviewed during the planning phase
   e. Plan the work and then work the plan
   f. The planning phase involves the following tasks
      (1) Definition of committee structure
      (2) Definition of requirements and/or stated goal
      (3) Feasibility study
      (4) Gap analysis
      (5) Documentation and negotiation of project scope document
      (6) Development of a high-level workplan
      (7) Allocation of resources
6. Definition of the project's purpose
   a. Definition of the project's purpose/stated goal is essential and often not readily apparent
   b. Not until the information requirements of the project and/or stated goal and outcomes are precisely defined will the real characteristics of the requirements be revealed
   c. The project definition includes a description of how the system will be evaluated
   d. Establishing the evaluation criteria early in the process supports the successful management philosophy of beginning with the end in mind
   e. The results and improvements expected from implementing the system are described by realistic goals for the system
   f. They might include increased functionality, decreased costs, increased personnel productivity, and meeting Federal Meaningful Use requirements
   g. When updating or expanding the EHR or application, the project definition includes
      (1) The identification of equipment currently available
      (2) Its age, the degree of amortization
      (3) The need for hardware or operating system software upgrades prior to undertaking an upgrade project
7. Feasibility study
   a. A feasibility study is a preliminary analysis to determine if the proposed problem can be solved by the implementation of an EHR or component application
   b. The feasibility study
      (1) Not only clarifies the problem and/or stated goal
      (2) But also helps to identify the information needs, objectives, and scope of the project
   c. The feasibility study helps the EHR steering committee understand the real problem and/or goal
      (1) By analyzing multiple parameters
      (2) And by presenting possible solutions
   d. It highlights whether the proposed solution will produce usable products and whether the proposed system's benefits more than justify the costs
   e. Operational issues are reviewed to determine if the proposed solution will work in the intended environment
   f. Technical issues are reviewed to ensure the proposed system
      (1) Can be built
      (2) And/or will be compatible with the proposed and/or current technology
   g. Legal and statutory regulations are reviewed to ensure compliance with local and federal law
   h. The feasibility study includes
      (1) A high-level description of the human resources required
      (2) And how the selected system will be developed, utilized, and implemented
   i. The feasibility study describes the management controls to be established for obtaining
      (1) Administrative
      (2) Financial
      (3) Technical approvals to proceed with each phase of the project
   j. The feasibility study seeks to answer the following questions:
      (1) What is the real problem to be solved and/or stated goal to be met?
      (2) Where does the project fit into the overall strategic plan of the organization?
      (3) What specific outcomes are expected from the project?
      (4) What are the measurable criteria for determining project success from the above outcomes?
      (5) What research and assumptions support the implementation project?
      (6) What are the known limitations and risks to the project?
      (7) What is the timing of the remaining phases of the project?
      (8) Who will be committed to implementing the project?
      (9) What are the estimated costs in both dollars and personnel time?
      (10) What is the justification for the project, including the relationship between costs and benefits?
8. Statement of the Objective
   a. The first step in conducting a feasibility study is to state the objectives for the proposed system

  - **b.** These objectives constitute the purpose(s) of the system
  - **c.** All objectives are outcome-oriented and are stated in measurable terms
  - **d.** The objectives identify the "end product" by defining what the EHR will do for the end users

9. Environmental assessment
  - **a.** The project is defined in terms of the support it provides to both the mission and the strategic plans of the organization
  - **b.** The project is evaluated relative to the organization's competition
  - **c.** The impact of legal, regulatory, and ethical considerations is reviewed
  - **d.** The regulatory impact of the Meaningful Use criteria is far reaching
  - **e.** Often one resource is assigned to assure each Meaningful Use criteria will meet the HITECH requirements
  - **f.** Individual software vendors often provide "best practice" guidelines demonstrating their software's intended functionality relative to Meaningful Use criteria

10. Scope
  - **a.** The scope of the proposed system
    - **(1)** Establishes system constraints
    - **(2)** Outlines what the proposed system will and will not produce
  - **b.** Included in the scope are the criteria by which the success of the project will be judged
  - **c.** The Scope Document
    - **(1)** Outlines the boundaries of the project
    - **(2)** Establishes responsibilities for each team member
    - **(3)** And sets up procedures as to how the completed work will be verified and approved

11. Timeline
  - **a.** A project timeline is developed to provide an overview of the key milestone events of the project
  - **b.** The projected length of time for each major phase of the project is established
  - **c.** Often called a project workplan
  - **d.** The major steps required for the project are outlined in sufficient detail to provide the steering committee
    - **(1)** Background on the proposed development
    - **(2)** Or implementation process

12. Recommendations
  - **a.** Committees may lose sight of the fact that not all projects are beneficial to the strategic mission of the organization
  - **b.** A decision can be made not only to proceed but also not to proceed, with a project
  - **c.** The viability of the project is based on the review of the multiple factors researched in the feasibility study
  - **d.** It is critical to consider whether more personnel or equipment is necessary rather than more computerization
  - **e.** In addition to identifying potential hardware and software improvements, the costs and proposed benefits are factored into the project's viability decision
  - **f.** In upgrading or considering expansion of a system
    - **(1)** A concerted effort to maximize use of the current system
    - **(2)** And to make process improvements in the current management and coordination of existing systems should be undertaken before deciding to procure a new system(s)
  - **g.** If based on the findings of the feasibility study, the project steering committee determines to continue with the project, a project scope agreement is prepared

13. Documentation and negotiation of a project scope document
  - **a.** A project scope document is drafted by the project team and submitted to the project's steering committee for acceptance
  - **b.** The project scope document includes
    - **(1)** The scope of the project, the application level management requirements
    - **(2)** The proposed activation strategy for implementing the EHR or application
    - **(3)** And the technical management and personnel who will implement and maintain the equipment and programs
  - **c.** The Scope document is based on the findings of the feasibility study
  - **d.** The project scope document becomes the internal organizational contract for the project
  - **e.** The project scope document
    - **(1)** Defines the short- and long-term goals
    - **(2)** Establishes the criteria for evaluating the success of the project
    - **(3)** And expands the workplan to include further detail regarding the steps to be accomplished in the development or implementation of a system or application

14. Resource planning
  - **a.** An important step in the planning phase is to determine what resources are required to successfully carry out the agreed upon project scope
  - **b.** A firm commitment of resources for development of the entire EHR project includes all phases of implementation and is for the system to fulfill its stated objectives
  - **c.** The following points should be considered when planning for resources:
    - **(1)** Present staffing workload
    - **(2)** Human resources (i.e., number of personnel, experience and abilities, and percentage of dedicated time to the project)
    - **(3)** Present cost of operation
    - **(4)** Relationship of implementation events with nonproject events (e.g., the Joint Commission accreditation process, state certification inspections, peak vacation and census times, union negotiations, and house staff turnover)
    - **(5)** Anticipated training costs
    - **(6)** Space availability
    - **(7)** Current and anticipated equipment requirements for the project team

  - **d.** Highly successful projects have spent the requisite amount of time to thoroughly complete the planning phase
  - **e.** Further, successful organizations have communicated to senior management and administration's project expectations through dissemination of the project scope document to all departments in the organization

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Analysis Phase

Teaching Tip

Provide the following information, the system analysis phase, the second SLC phase of developing an EHR, is the fact-finding phase. All data needs related to the requirements are defined in the project scope agreement developed in the Analysis Phase.

Key documents created in this phase are:

- Gap Analysis
- Technical requirements for hardware, software, networks
- Functional Design Document
- System Proposal Document

1. Data collection
  - **a.** The collection of data reflecting the existing problem or goal is the first step in the system analysis phase
  - **b.** As a result of thorough data collection, refinements to the project scope agreement may occur
  - **c.** Added benefits to the organization may be realized through the small refinements
  - **d.** Larger project scope refinements should be carefully researched and evaluated (using the steps outlined in the feasibility study methodology) prior to requesting a major project scope change
  - **e.** Large or small, all changes must continue to support the goal(s) of the project and the strategic plan of the organization
  - **f.** Two important documents are created as a result of data collection
    - **(1)** The first is the creation of a workflow document for each major goal or problem to be resolved by the implementation of the new software or system
    - **(2)** The second is a functional design document outlining how the new system will resolve the identified goals/problem
2. Gap analysis
  - **a.** Drawing on the work completed in the Planning phase, the workflow document, and the system proposal document from the analysis phase
    - **(1)** A comparison of what is available in the current processes
    - **(2)** And what is desired in the new system is completed
  - **b.** Often referred to as a Gap Analysis
    - **(1)** The comparison provides the project team with a list of features and functions desired
    - **(2)** But not immediately available in the new system/application
  - **c.** The departmental teams
    - **(1)** Review the features/functions and estimated costs
    - **(2)** Evaluate alternatives to achieving them
    - **(3)** And make recommendations to the Steering Committee
  - **d.** Features/functions
    - **(1)** May be delayed to a subsequent activation phase of the project
    - **(2)** Lobbied for inclusion in the current activation plan
    - **(3)** Or eliminated from the project
  - **e.** Data is collected and analyzed
    - **(1)** To gain a sound understanding of the current system, 'Current State"
    - **(2)** How it is used
    - **(3)** And what is needed from the new system
  - **f.** Process analysis is foundational to the actual system design, since it examines
    - **(1)** The objectives and project scope in terms of the end-user requirements
    - **(2)** The flow of information in daily operation
    - **(3)** And the processing of required data elements
  - **g.** Through the analysis effort
    - **(1)** The individual data elements
    - **(2)** Interfaces
    - **(3)** And EHR decision points of the project are identified
  - **h.** The "Future State"—how the system will look and function upon completion of the implementation begins to take shape
  - **i.** Review of the requirements of the Americans with Disability Act is done to assure compliance with special needs of staff
  - **j.** Stakeholders review the document to assist in the prioritization of problems/issues to be resolved
  - **k.** Current costs and resources required for processing the organization's volume of data are compared with estimates for the cost of processing with the new system
  - **l.** If a system is being upgraded or expanded, the current equipment and functions are described
  - **m.** Careful evaluation is undertaken to ensure compatibility with the new system's requirements and to maximize the use of available equipment as long as possible
  - **n.** Depreciation costs of available equipment and projected budget expenditures are reviewed
  - **o.** The importance of this phase should not be underestimated
  - **p.** Design changes
    - **(1)** Made during the analysis stage often add minimal costs to the project

- **(2)** As the project progresses to the development and implementation phases, the cost of programmatic or design changes increases dramatically

q. When a project is in

- **(1)** The planning phase, the relative cost to make a design change or fix an error is one
- **(2)** The analysis phase, the relative cost to fix the error/design change is three to six times that of the planning phase

r. The relative cost to fix an error or change a system design jumps to 40–1000 times once the system is operational

3. Technical analysis

- **a.** A review of the project's technical requirements is conducted in the Analysis Phase
- **b.** Trained/certified technical personnel review the requirements for EHR software to run efficiently
- **c.** This may include programs to run the
  - **(1)** EHR software
  - **(2)** Hardware
  - **(3)** Networks
- **d.** Physical requirements for
  - **(1)** Space
  - **(2)** Electrical needs
  - **(3)** And air conditioning/cooling are considered
- **e.** A technical architecture is developed to assure
  - **(1)** The speed of data transmissions
  - **(2)** Sufficient storage capability to meet clinical and financial requirements over time
- **f.** These requirements in conjunction with costs are evaluated and compiled into technical recommendations for the project

4. Determination of information needs

- **a.** A needs assessment outlines the high-level information required by multidisciplinary users
- **b.** Standard terminology use as defined by CMS and ONC is critical to meeting Federal Meaningful Use requirements
- **c.** The number of federally mandated data elements is significant, and increase with each Meaningful Use stage
- **d.** Planning for the data collection across an organization's multiple departments and clinician work flow is imperative to successfully meet the requirements of the HITECH Act
- **e.** Workflow review and identification of the information needed clarify what users will expect from the system and how it can be collected in the course of daily operations
- **f.** Such knowledge is essential in designing the system's output, input, and processing requirements constituting the basis for the new "Future State"

5. Workflow document

- **a.** The workflow document assimilates the data collected into logical sequencing of functions/tasks performed by the end users for each goal or problem area
- **b.** Departmental standards of care, ordering patterns, procedures, operating manuals, reports (routine, regulatory, and year-end), and forms used in day-to-day operations are collected
- **c.** Individual data elements required by clinicians in each department are identified and analyzed for continuity, duplication, and cross referenced to the required HITECH data elements
- **d.** The workflow document includes the following
  - **(1)** A list of assumptions about the process or work effort
  - **(2)** A list of the major tasks performed by the user
  - **(3)** A list of the subtasks and steps the user accomplishes and outlines whether the determination of optional or required status for each task
  - **(4)** The frequency of the task being performed
  - **(5)** The criticality and important factors of the tasks/subtasks
  - **(6)** The order of the subtasks
  - **(7)** The number and frequency of alternate scenarios available to the end user to accomplish a particular task
- **e.** There are multiple sources of data for completing a workflow document
- **f.** These include the following
  - **(1)** Written documents, forms, and flow sheets
  - **(2)** Policy and procedure manuals
  - **(3)** Questionnaires
  - **(4)** Interviews
  - **(5)** Observations
  - **(6)** Development of workflow diagrams utilizing available software is most helpful in documenting the flow of information, people, and processes involved in the "Current State"
- **g.** The graphic representation provided by workflow diagrams allows a clear visualization of the gains proposed in the "Future State"

6. Functional design document

- **a.** The functional design document is the overview statement of how the new system will work
  - **(1)** It uses the workflow documents as its base
  - **(2)** Adding the critical documentation of the integration of each of the workflow documents to create a new system
  - **(3)** Implement a commercial software application
  - **(4)** Or upgrade a system
- **b.** The functional design document, in this phase
  - **(1)** Outlines the human and machine procedures
  - **(2)** The input points
  - **(3)** The processing requirements
  - **(4)** The output from the data entry
  - **(5)** And the major reports to be generated from the new system
- **c.** The functional design
  - **(1)** Is a description of the functions required from the proposed EHR system or component
  - **(2)** And describes how tasks will be accomplished

- **d.** From the functional design document, database structure will be determined
- **e.** Two data types are often used in databases
  - **(1)** Free text data (allowing the user to describe a response in their own words)
  - **(2)** And discrete data (structured data presented in application via check boxes or drop down lists)
- **f.** Discrete data elements with links to standard terminology are the preferred data type
- **g.** They increase the ability to report on and compare data
- **h.** Meaningful Use 2014 requirements include the use of structured data linked to standard terminologies such as
  - **(1)** SNOMED-CT (Structured Nomenclature of Medicine—Clinical Terminology)
  - **(2)** And LOINC (Logical Observation Identifiers Names and Codes used for laboratory tests)

Teaching Tip
See also the chapter on Terminologies.

- **i.** When new software is being created, the functional design document provides the programmers with
  - **(1)** A view of screens
  - **(2)** Linkages
  - **(3)** And alternate scenarios to accomplish a task
- **j.** Initial programming efforts can begin once the functional design is accepted
- **k.** In the instance where a commercially available system or application is being implemented
  - **(1)** The functional design outlines how the end users will use the system's programs to accomplish their tasks
- **l.** In some cases, commercial software provides multiple pathways to accomplish a single task
- **m.** The functional specification may suggest deploying a limited number of available pathways

7. Data analysis
- **a.** The analysis of the collected data is the second step in the analysis phase
- **b.** The analysis provides the data for development of an overview of the clinical requirements and/or stated goal defined in the project scope agreement
- **c.** Several software tools can be used in the development of the workflow and functional design documents and are discussed in the Tools Chapter

8. Data review
- **a.** The third step in the analysis phase is to review the
  - **(1)** Data collected in the feasibility study
  - **(2)** Workflow documents
  - **(3)** And the functional specification and provide recommendations to the project steering committee for the new system
- **b.** The review focuses on system requirements and/or attaining the project goals outlined in the feasibility study based on the best methods or pathways derived from the workflow documents and the functional design
- **c.** Recommendations for streamlining workflow are suggested
- **d.** The success of an EHR implementation project rests on the ability of the departmental and project teams
  - **(1)** To analyze the data
  - **(2)** And propose solutions benefiting the total organization without favoring certain departments at the expense of others
- **e.** The benefits of a thorough, structured analysis provide objective data to support the EHR
- **f.** The careful analysis of end-user requirements and potential solutions has been proven to reduce the cost of design and implementation

9. Benefits identification
- **a.** The overall anticipated benefits from the system are documented in the fourth step in the system analysis process
- **b.** The benefits
  - **(1)** Are stated in quantifiable terms
  - **(2)** And become the criteria for measuring the ROI and success of the project

10. System proposal development
- **a.** The final document created in the system analysis stage is a system proposal document
- **b.** The proposal is submitted to the project's steering committee for review and approval
- **c.** It sets forth the problems and/or goals and the requirements for the new system's overall design
- **d.** It outlines the
  - **(1)** Standards
  - **(2)** Documentation
  - **(3)** And procedures for management control of the project
  - **(4)** And it defines the information required, the necessary resources, anticipated benefits, a detailed workplan, and projected costs for the new system
- **e.** The system proposal furnishes the project steering committee with recommendations concerning the proposed EHR or application
- **f.** The system proposal document answers four questions
  - **(1)** What are the major problems and/or goals under consideration?
  - **(2)** How will the proposed EHR solution correct or eliminate the problems and/or accomplish the stated goals?
  - **(3)** What are the anticipated costs?
  - **(4)** How long will it take?
- **g.** The system proposal describes the project in sufficient detail to provide a management level understanding of the system or application without miring in minutiae
- **h.** Much of the information required in the system proposal is collected in the earlier phases of the analysis
- **i.** It has been suggested this proposal is best accepted when
  - **(1)** Presented as a business proposal
  - **(2)** And championed by a member of the project's steering committee

- **j.** The format of the final system proposal includes the following information
  - **(1)** A concise statement of the problem(s) and/or goal(s)
  - **(2)** Background information related to the problem
  - **(3)** Environmental factors related to the problem
  - **(4)** Competition
  - **(5)** Economics
  - **(6)** Politics
  - **(7)** Ethics
  - **(8)** Anticipated benefits
  - **(9)** Proposed solutions
  - **(10)** Budgetary and resource requirements
  - **(11)** Project timetable
- **k.** Acceptance of the system proposal by the project steering committee provides the project senior management support
- **l.** Following acceptance by the project steering committee, it is not unusual for major EHR proposals to be presented to the institution's governing board
  - **(1)** For their acceptance and approval
  - **(2)** And to receive funding
- **m.** Often the requirement for board approval is dependent on the final cost estimates of the system
- **n.** Acceptance of the proposal by the project steering committee and the governing board
  - **(1)** Assures not only funding for the project
  - **(2)** But critical top-down management and administrative support for the project
- **o.** The final system proposal is an internal contract between the EHR committees/teams (steering, project, and departmental) and the institution
- **p.** As noted earlier, the active support and involvement of all senior executives in the development of the feasibility study are essential
- **q.** The championing of the final system proposal greatly enhances the chances of acceptance of the system proposal

System Design, Development, and Customization Phase

Teaching Tip

Provide this information, in this phase, the design details to develop the system and the detailed plans for implementing and evaluating the system evolve for both the functional and the technical components. Data dictionaries are populated with entries and project teams work to assure the functional design supports the clinician and departmental workflows. Policies and procedures are reviewed and updated to reflect the use of the new application/system in the delivery of care. Thorough testing of the new system occurs and detailed plans, developed in this, as well as previous phases, are executed.

There are multiple project documents created in this phase

- (1) Gap analysis
- (2) Functional specifications
- (3) Technical specifications
- (4) Implementation Workplan containing plans specific to
  - **i.** Hardware & Peripheral Devices
  - **ii.** Interfaces
  - **iii.** Testing
  - **iv.** End User Training
  - **v.** Cut Over Plan
  - **vi.** Go Live Plan
- (5) Post Live Evaluation Reports

1. System design
- **a.** The project teams receive application training often directly from the vendor
- **b.** In some cases a limited number of team members attend training with the expectation they will train other team members
- **c.** The Project Teams determine the best utilization of functionality based upon
  - **(1)** The identified elements of project goals
  - **(2)** Scope
  - **(3)** Software functionality
  - **(4)** And the organization's workflow
- **d.** The definition of current workflow, documented in the analysis phase, serves as the bases for changes, both programmatic and process oriented, required to support the new system's workflow

2. Functional specifications
- **a.** The functional specifications
  - **(1)** Use the functional design document developed in the system analysis phase of an EHR
  - **(2)** And builds on the design by formulating a detailed description of ALL system inputs, outputs, and processing logic required to complete the scope of the project
- **b.** It further refines what the proposed system
  - **(1)** Will encompass
  - **(2)** And provides the framework for its operation
- **c.** Commercial software vendors generally
  - **(1)** Provide a detailed functional specification document for their system
  - **(2)** Or application in the form of manuals
- **d.** The manuals usually application-specific include
  - **(1)** An introduction,
  - **(2)** A section for each workflow
  - **(3)** And a technical section
- **e.** From the provided documentation, the hospital's departmental and project teams produce the organization's functional specification
  - **(1)** By evaluating the available commercial software's functions with the organization's workflow documents
  - **(2)** And making decisions on the functionality to be used by the institution

f. The detailed functional specifications are critical to
  (1) The system's acceptance
  (2) Each screen
  (3) Data flow
  (4) And report the user can expect to see is analyzed

g. The examples incorporate real data into the explanations and drawings

h. The technical aspects of the HITECH Act and Meaningful Use criteria must be carefully understood and followed including
  (1) The use of both evidence-based medicine links
  (2) And clinical decision support rules for patient safety within clinical workflows

Teaching Tip
Additional information can be found at: http://www.healthit.gov/providers-professionals/ehr-implementation-steps/step-5-achieve-meaningful-use

i. During this step, the departmental teams and users
  (1) Determine what the actual data will look like in its output form
  (2) And they gain consensus from the departmental teams for the proposed workflow design

j. Requirements for meeting the HITECH—Meaningful Use data collection are integral to completing the functional specifications

k. In-depth understanding of the federal criteria, layered with thoughtful implementation planning and execution will lead to staff's universal adoption of new data collection and data sharing procedures

l. There is fluidity between the functional specification and initial programming prototype efforts

m. The design team creating the new application often works closely with the programmers
  (1) Making adjustments in the design and specification based on federal requirements
  (2) Programming logic
  (3) Newly identified information needs
  (4) And/or technologies

n. As the functional specification matures and major design decisions have occurred, a design freeze point is established

o. This indicates
  (1) The functional specification is complete
  (2) And full programming efforts can begin

p. Once completed, the functional specification provides
  (1) Not only the road map for programming efforts
  (2) But the starting point for developing, testing, and training plans

q. The advantages of establishing testing plans in concert with the development of the functional specification include
  (1) A more thorough test plan (workflows are not missed)
  (2) And "what if" questions often spark the need to develop or allow alternate workflow

3. Technical specifications

a. In the system design phase, technical personnel work closely with the project and departmental teams to
  (1) Ensure the components of the proposed system work in concert with technology and end-user needs
  (2) And to assist in the development of the implementation plan

b. A dedicated technical manager is required

c. He or she is responsible for the coordination of efforts in five major areas
  (1) Hardware
  (2) Networks
  (3) Software
  (4) Interface application
  (5) Legacy system data conversion

d. Detailed technical specifications are developed for each area

e. The project's technical manager and team leaders ensure all of the components/applications of the EHR work in concert with all the other components

4. Hardware

a. In the case of new software development, the technical project manager ensures the new software uses the best technology platform available

b. The ability to operate the new application on multiple hardware platforms is often desired

c. Technical specifications describing the recommended equipment are developed and tested in the development laboratory

d. When commercial software is being implemented or upgraded, the technical project manager ensures the physical environment for the new system conforms to the new system's technical specifications

e. This may include
  (1) The need to build a new computer room
  (2) Establish or upgrade a network
  (3) And procure the correct devices for the new system

f. The types of devices to be used require dialog and testing with team leaders and department team members

g. The testing and deployment of the new equipment are the responsibility of the technical manager

h. Ongoing maintenance requirements for the new system's
  (1) Processing unit
  (2) Operating systems
  (3) And network is coordinated by the project's technical manager

i. Selecting the correct hardware for the system depends on its
  (1) Design
  (2) Application
  (3) And software requirements

- **j.** Technical conditions may dictate selection of a
    - **(1)** Mainframe
    - **(2)** Minicomputer
    - **(3)** Microcomputer
    - **(4)** Or a combination of the above
- **k.** Computer hardware is obtained in several different ways
- **l.** Central processing
    - **(1)** May be purchased or leased from a hardware vendor for in-house use
    - **(2)** However, when cost is a significant factor, timesharing computer processing with other facilities may be considered
- **m.** Many Internet Web hosted medical applications are now available
- **n.** The technical manager must evaluate such offerings
    - **(1)** In light of interoperability with the main hospital information system
    - **(2)** As well as data security during transmissions to and from the Web
- **o.** Input, output, and processing media, including secondary storage, is selected

5. Peripheral Device Plan

- **a.** Knowledge of the many clinical workflows is an important component of the Peripheral Device Plan
- **b.** There are now many types of devices available to clinicians to support their daily workflow

Teaching Tip
Provide the information, for some data collection, wireless tablets may work well when full features and functions are needed. For other data collection, smaller handheld devices may provide connectivity for limited data collection needs.

- **c.** Nurse Informaticists are integral in
    - **(1)** Reviewing the primary needs of each stakeholder
    - **(2)** Suggesting a limited number of companies/devices to trial
    - **(3)** And providing the compilation of the trial evaluation data
- **d.** Nursing Informaticians and the technical team work together to assure all hardware is installed and tested at the appropriate time

6. Networks

- **a.** Proliferation of
    - **(1)** Web-based applications
    - **(2)** And reference/search engines
    - **(3)** In addition to the locally based EHR necessitates a thorough review of the current and anticipated volume of transactions and high utilization times for accessing the EHR
- **b.** The EHR no longer resides simply within the walls of a hospital
- **c.** Health systems comprised of
    - **(1)** Inpatient
    - **(2)** Outpatient
    - **(3)** Long term care
    - **(4)** Home Health,
    - **(5)** And patient access are variables to be considered when determining the size and types of networks

7. Application software

- **a.** The project's technical manager is responsible for establishing the technical specifications outlining the operational requirements for the new system
- **b.** The specifications detail the procedures required to maintain the application software on a daily, weekly, and monthly basis
- **c.** The specifications are compiled as the starting point for determining the operations schedule for the system and/or the institution
- **d.** The operations plan includes detailed information related to
    - **(1)** When the system will be scheduled for routine maintenance
    - **(2)** Plans for operations during system failures
    - **(3)** And acceptable periods, if needed, during the week/month for the system to be unavailable to the users
- **e.** Additional requirements for assuring data reliability and availability following planned and unplanned system downtime, as well as procedures outlining data recovery following a downtime are developed
- **f.** Change control policies and procedures for
    - **(1)** Identifying
    - **(2)** Tracking
    - **(3)** Testing
    - **(4)** And applying software fixes are established
- **g.** With the popularity of Web-based systems, Web design, maintenance and security have added a level of complexity to maintaining a system within a healthcare environment's security regulations
- **h.** Often niche software

Teaching Tip
Provide the examples, patient portal, secure texting software, e-prescribing, appointment scheduling, preventative healthcare alerts compliments the central hospital information system.

- **i.** Requirements of each must be reviewed and outlined in the technical specifications

8. Interface applications

- **a.** An interface system defines those programs and processes required to transmit data between disparate systems
- **b.** The project's technical manager coordinates all interfacing activities for the new application
- **c.** While utilization of the industry's Health Level Seven (HL7) interface standards has greatly reduced the effort

required to establish clinical interfaces by providing a standard specification for the transmission of data, the number of clinical interfaces in an EHR has dramatically increased

- **d.** It is not unusual for an EHR to interface with separate
  - **(1)** Registration
  - **(2)** Patient billing
  - **(3)** Ancillary departmental systems
  - **(4)** As well as multiple types of wireless devices
- **e.** With the advent of HIEs, patient data will be sent via interfaces outside a healthcare systems domain
- **f.** Interface developments advocate the use of an interface engine decreasing the number of individual interfaces to be managed

Teaching Tip
System security is detailed in another chapter of this book.

- **g.** Meaningful Use Stage 2 requirements encompass the ability to
  - **(1)** Share data electronically with Federal and local agencies
  - **(2)** As well as with the patient. Implementation and use of an Internet portal by patients is a Meaningful Use Stage 2 requirement
- **h.** Adherence to the Federal Meaningful Use data and transmission criteria is, therefore, essential
- **i.** More complex environments may include interfaces
  - **(1)** To physiologic monitors
  - **(2)** And wireless portable devices
  - **(3)** And provide remote access into the healthcare network's clinical system for physicians and their staff
- **j.** The interface specification details whether the interface will be one-way or bidirectional
- **k.** A bidirectional interface implies data are flowing both to and from a system
- **l.** A one-way interface may either send data to or receive data from a separate system but not do both
- **m.** An important process in the development of the interface specification is the comparison of data elements in each system in order to determine the data elements and their technical format be included in the interface

9. Legacy systems data conversions

- **a.** The conversion of data from legacy systems to a new system is a major area of coordination for the project's technical manager
- **b.** Most hospitals currently use automated registration and billing systems
- **c.** Determining the conversion requirements and developing and testing the conversion programs are critical steps in implementing a new system or application
- **d.** While all steps are important in the implementation of a new system
- **e.** The interface and conversion design and testing tasks are frequent areas causing project delays
- **f.** The importance of oversight and communication by the project technical manager to keep the technical tasks on the established timetable should not be underestimated

10. Development

- **a.** Multiple plans are developed during this portion of the Design, Develop, Implement, and Evaluate Phase
- **b.** The detailed implementation workplan encompasses the multiple plans targeting specific aspects of the EHR
- **c.** Often the appropriate departmental teams are responsible for creating the details for a focused plan
- **d.** Together with the Project Manager and Team leaders, the focused plans are incorporated into the implementation workplan
- **e.** At a minimum the following focused plans are required
  - **(1)** Communications Plan
  - **(2)** Hardware and Peripheral Devices plan
  - **(3)** Interface plan
  - **(4)** Conversion plan
  - **(5)** Testing plan
  - **(6)** End-User Training plan
- **f.** The developed functional and technical specifications define a significant amount of form and substance for the new EHR
- **g.** The next step is to assess the timeframes established in the final scope document with the development timeframes established during the system design and the interface and conversion requirements to establish a detailed workplan
- **h.** The workplan
  - **(1)** Identifies a responsible party
  - **(2)** And a beginning date and end date for each phase, step, task, and subtask
- **i.** This plan coordinates all tasks necessary to
  - **(1)** Complete the development of new software
  - **(2)** Implement a new system
  - **(3)** And/or upgrade a current system
- **j.** Many software vendors and consultants provide an implementation workplan for their system or applications
- **k.** The supplied workplans must be reviewed and revised to meet
  - **(1)** The individual needs
  - **(2)** And timetables of the organization's project
- **l.** Automated workplan software is available to create and monitor a project/implementation plan
- **m.** The implementation checklist describes the high-level tasks to be included in clinical implementation workplans
- **n.** It is advisable to take advantage of automated software and existing plans

Teaching Tip
Provide the information, Figure 11.4 provides an example of detailed workplan based on the checklist.

- **o.** Whether the project is software development or the implementation or upgrading of a system, the implementation workplan details the following
    - **(1)** Personnel
    - **(2)** Timeframes
    - **(3)** Costs and budgets
    - **(4)** Facilities and equipment required
    - **(5)** Operational considerations
- **p.** A successful implementation ensures all checklist items are
    - **(1)** Planned
    - **(2)** Executed
    - **(3)** And tracked by the project manager and project team leaders

11. System selection

- **a.** In the instance where commercially available software is being considered, the key documents completed in earlier phases assist in beginning the system selection process
- **b.** The task of selecting a new system becomes more objective as a result of the thoughtful evaluation for the functional specification and design document
- **c.** The process and documents provide the steering committee and project team with information to objectively evaluate commercial system offerings
- **d.** The system proposal document also assists the institution's legal team in formulating a contract with the software vendor as well as providing the basis for the development of a formal RFP or RFI to potential vendors

12. Request for Proposal (RFP)/Request for Information (RFI)

- **a.** The creation of an RFI document is sent to selected vendors indicating the organization's interest in gaining knowledge about the vendor's products
- **b.** At a high level, the key features desired for the new system are listed
- **c.** Vendors respond to the RFI with their product's likely ability to meet the high-level requirements
- **d.** Additional knowledge about available technical solutions not considered is often gained from the RFI responses
- **e.** The project team reviews the responses and selects two to four vendors meeting the majority of the high-level requirements
- **f.** An RFP document is
    - **(1)** Created by the project team
    - **(2)** And sent to the selected vendors outlining in greater detail the features and functions desired for the new system
- **g.** Clinical and financial workflow scenarios as well as the desired functions developed by the project team can be included in the RFP
- **h.** The vendor RFP responses are equally detailed
- **i.** They are closely evaluated both from the written responses and during subsequent in-person or webinar style demonstrations of their product
- **j.** A number of system evaluation tools have been published
- **k.** A heuristic method relies on information common to the evaluators in assessing the usability of a system
- **l.** The 14 point tool, termed the Nielsen-Shneiderman Tool provides a list of areas to be assessed during the review and evaluation of systems or applications
- **m.** Preparation activities for project team members evaluating demonstrations of systems or applications for purchase
    - **(1)** Should include a discussion of aspects of the evaluation tool to be used
    - **(2)** And the definition of the criteria to increase objectivity in the selection process

Teaching Tip
Provide the examples, Figures 11.5 and 11.6 are examples of tools utilized in evaluating the cost and potential usability of prospective vendors' software.

13. Communications plan

- **a.** Healthcare systems or applications often affect more than one department
- **b.** Results from a laboratory system are reviewed by clinicians; the pharmacy system utilizes creatine results to adjust medication dosages for renal impaired patients
- **c.** Documented nursing observations are utilized by case management, providers, and insurance companies
- **d.** New functionality must be planned and communicated to all stakeholders
- **e.** A communications plan is often created in conjunction with the organization's public relations department.
- **f.** The plan is developed to
    - **(1)** Promote frequent face-to-face communications among departments
    - **(2)** To multiple levels of administration
    - **(3)** And to external stakeholders
- **g.** Communications to all stakeholders/constituents affected by the project are developed
- **h.** Segment-targeted communications plans are developed
    - **(1)** Identifying the type
    - **(2)** Content level
    - **(3)** And media for information dissemination to each identified stakeholder
- **i.** Rarely have staff complained of receiving too much information about a new process or change

Teaching Tip
Provide the example, more often the complaint is "… no one told us!"

- **j.** Multiple communication mediums are utilized, including but not limited to
    - **(1)** Verbal updates presented at departmental/staff meetings
    - **(2)** Fact sheets/newsletters/flyers

    - **(3)** Faxes, e-mail, and Web site posting
    - **(4)** Social media/blogs
  - **k.** The communication plan, once developed and executed, must be monitored and modified as the implementation progresses
  - **l.** Up to this point, thorough planning and thoughtful design discussions have been held
  - **m.** During Development
    - **(1)** The decisions are actualized with the entry of elements into the data dictionaries
    - **(2)** Comparison of the clinical and departmental workflow for those created in the system
  - **n.** The functional specification indicating how the departments and clinicians want the system to work and the workflow document describing to how processes are carried out are established by populating in the data dictionaries
  - **o.** The plans for Interfaces, Conversions, Testing, Communications, and Training are carried out
- **14.** Policies and procedures
  - **a.** Policy and procedure reviews are
    - **(1)** Conducted
    - **(2)** Revisions reflecting changes being implemented with the new system/application workflows
  - **b.** It is advisable to
    - **(1)** Complete the policy reviews
    - **(2)** And complete procedure revisions prior to the start of end-user training
- **15.** Workflow, dictionaries, and profiles
  - **a.** In this portion of the phase, project team members review data requirements and workflow previously documented
  - **b.** Data dictionaries and profiles are populated with entries to establish desired new system workflow
  - **c.** This becomes an iterative process of
    - **(1)** Populating data dictionaries with values supporting the workflow design and functional specification
    - **(2)** Testing the design with the project team
    - **(3)** Evaluating options suggested as a result of testing
    - **(4)** And refining/reevaluating the functional specification
  - **d.** As data dictionaries are established, project teams begin to develop clinical decision support functions
  - **e.** Clinical decision support helps healthcare providers make clinical decisions
  - **f.** Clinical Decision Support Software (CDSS) is software designed to support clinical decision making

Teaching Tip
Refer to the textbook for more detailed definitions for clinical decision support and CSSS.

  - **g.** Two main types of clinical decision support systems exist
  - **h.** One type uses a knowledge base while systems without a knowledge base rely on machine learning to analyze data
  - **i.** The challenge for the project team is to find the correct balance of the number and types of alerts presented to the clinician
  - **j.** Clinical alert fatigue is a well-documented phenomena

Teaching Tip
Refer to the textbook of a more detailed discussion for clinical alert fatigue.

- **16.** Testing
  - **a.** The system, whether newly developed or commercially available
    - **(1)** Must be tested to ensure all data are processed correctly
    - **(2)** And the desired outputs are generated
  - **b.** Testing verifies
    - **(1)** The computer programs are written correctly
    - **(2)** And when implemented in the production (live) environment, the system will function as planned
  - **c.** System implementation requires three levels of testing
  - **d.** The first level is often called a functional test
    - **(1)** During this round of testing, the departmental teams test and verify the databases (files, tables, data dictionaries), ensuring correct data have been entered into the system
    - **(2)** The expected departmental reports are reviewed to assure correctness and accuracy
    - **(3)** Multiple iterations of the functional test often occur until the departmental team is confident the system setup and profiles support the work of the department
  - **e.** The second level of testing, integrated systems testing, begins when all departments indicate successful completion of their functional testing
    - **(1)** During integrated testing, the total system is tested; this includes interfaces between systems as well as the interplay between applications within the same system
    - **(2)** The integrated test must mimic the production (live) environment in terms of the volume of transactions, the number of users, the interfaced systems, and the procedures to be followed to carry out all functions of the system
    - **(3)** It is at this point, organization-wide procedures to be instituted when the system is unavailable, often called downtime procedures, are thoroughly tested
    - **(4)** Downtime procedures must be taught during end-user training
    - **(5)** At the end of integrated testing, the organization makes a formal decision to proceed or postpone activation of the new systems
    - **(6)** Often referred to as the "Go-No Go" decision, members of the steering committee, project team, and technical staff review the outstanding issues from both unit and integrated testing to make their decision

- **f.** The final round of testing occurs during end-user training
    - **(1)** As more users interact with the new system, previously unfound problems may surface
    - **(2)** Evaluation of the severity of the newly discovered concerns and the corrective action required is an ongoing process during implementation

Teaching Tip
Significant information on testing processes and tools can be found in a later chapter.

17. End-user training

- **a.** It is essential to train the end users on how to use the system in their daily workflow
- **b.** An EHR will function
    - **(1)** Only as well as its users understand its operation
    - **(2)** And the operations, streamline their workflow
- **c.** Two levels of training take place for the implementation of a system
- **d.** The project team and selected members of the departmental team receive training from the developers or vendor
- **e.** This training details the databases (files and tables), processing logic, and outputs of all the system's features and functions
- **f.** End-user training takes place once the departmental and project teams have finished profiling the system to meet the functional and technical specifications developed and functional testing has been completed
- **g.** The preparation for end-user training necessitates a "mini-workplan" often developed and managed by a team led by the Education/Training department
- **h.** End-user training stresses how the user will complete his or her workflow using the system features and functionality

Teaching Tip
See also the Training Chapter.

- **i.** All users of the new system or application must receive training
- **j.** Training on a new system should occur no more than 6 weeks prior to the activation of the new system
- **k.** When training occurs for more than 6 weeks before activation of the system, additional refresher training is often required by the end users
- **l.** Training takes place before and during the activation of a new system.
- **m.** After system implementation, refresher courses as well as new employee introductory training on the use of the system are often provided by the institution
- **n.** The large number of provider, nursing and ancillary staff members to be trained necessitates a significant amount of advance planning
- **o.** Training is most effective when hands-on, interactive instruction is provided
- **p.** Training guides or manuals explain the system; however, retention of information is increased if the learners are able to interact with the new system in a manner simulating their workflow with the system
- **q.** Computer-assisted instruction (CAI) can be used to provide hands-on experience
- **r.** The often Web-based training provides the user opportunities for self-paced, on-demand learning
- **s.** End-user training is offered with two perspectives
    - **(1)** One perspective provides a general overview of the system
    - **(2)** And the second perspective explains how the user will interact with the system to complete his or her daily work
- **t.** While a training manual is developed for the training sessions
    - **(1)** Most end users express the desire to have a pocket size reminder ("cheat sheet") outlining the key functions of the new system or application
- **u.** Both the user's manual and the pocket reminders should be available for departmental use
- **v.** When possible, a training environment on the computer system should be established for the organization
- **w.** Establishing a training lab as well as providing access to the training environment from the departments and nursing units prior to the activation of the new system
    - **(1)** Provides end users the opportunity to practice
    - **(2)** At times convenient to their work requirements and reinforces the training

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Implement, Evaluate, Maintain, and Support Phase

1. System documentation

- **a.** The preparation of documents to describe the system for all users
    - **(1)** Is an ongoing activity
    - **(2)** With the development of the documentation occurring as the various system phases and steps are completed
- **b.** Documentation should begin with the final system proposal
- **c.** Several manuals are prepared
    - **(1)** A user's manual
    - **(2)** A reference manual
    - **(3)** And an operator's maintenance manual
- **d.** These manuals
    - **(1)** Provide guides to the system components
    - **(2)** And outline how the entire system has been developed

2. Implementation—Go Live
    a. Few, if any, healthcare organizations have the luxury to stop operations during an implementation
    b. Implementation encompasses
        (1) The Cut Over plan (data driven)
        (2) And the Implementation plan for the facility to continue to operate (people/processes) during this period
    c. Staffing, patient care delivery and support of the end user during the "Go Live" period are detailed within the "Go Live" plan
    d. The planning includes
        (1) Assuring patient care functions as smoothly as possible during the time between the cut off of the old system
        (2) And the start of processing on the new system
    e. Downtime functions/process and forms are reviewed to
        (1) Assure patient care and processing of data continues
        (2) And is able to be accurately reflected in the patient's record
    f. This often includes developing forms streamlining the documentation to be entered when the new system is available

Teaching Tip
Refer to Figure 11.7.

    g. Four activation approaches are possible
        (1) Parallel
            i. In the parallel approach, the new system runs parallel with the existing system until users can adjust
        (2) Pilot
            i. In the pilot approach, a few departments or units try out the new system to see how it works and then help other units or departments to use it
        (3) Phased-in
            i. In the phased-in approach, the system is implemented by one unit or department at a time
        (4) Big bang theory
            i. In the big bang approach, a cut-over date and time are established for the organization, the old system is stopped, and all units/departments begin processing on the newly installed system
    h. The timing of conversion activities and the activation of all interfaces require particular coordination between the technical staff and the project teams
        (1) The project's technical manager, in conjunction with the project manager, is responsible for assuring the development of thorough go live plans
        (2) A command center is established to coordinate all issues, concerns, and go live help desk functions
        (3) A sufficient number of phone lines and beepers/cell phones are secured to support the move to the live production environment
        (4) Team members and trainers often serve as resources to the end users on a 24-hour basis for a period of time post-implementation
        (5) Sometimes called "super users," these team members are available in the departments and on the nursing units to proactively assist users during the first 1–2 weeks of productive use of the new system or application
        (6) The coordination of all activities requires a cohesive team effort
        (7) Communication among the team members is foundational
        (8) End users are informed of the sequence events, the expected time frames for each event, and the channels established for reporting and resolving issues
        (9) Daily meetings of key team members to review issues and chart the progress of the new system are held
        (10) Decisions affecting the "Go Live" are made in a timely manner and require a thoughtful and thorough approach when changes to procedures and computer programs are contemplated
        (11) The executive team and senior management group are kept as up to date as the end users
        (12) The goal of most clinical implementations is to improve the delivery of information to the end user
        (13) The end-user suggestions and issues, therefore, must be tracked and resolved
        (14) Providing timely follow up to issues and suggestions will be critical to the success of the new system
        (15) Often, the informatics nurses are responsible for this follow up
    i. It is highly recommended to have all end-user logins, passwords and system devices and printers tested 5–7 days before the live
        (1) Requests for login and password support comprise the largest number of calls to the Command Center during the first few weeks of a new system's use
        (2) Clinical and departmental managers are in the best position to assure all staff have logged into the new system and have the appropriate role for their job requirements
        (3) Login issues are followed closely by printer issues during the first weeks of a new system
        (4) The Hardware team members can troubleshoot issues best if they have been given a script outlining one or two functions resulting in a printed output
        (5) Assuring these two areas are addressed completely prior to "Go Live" will dramatically lessen the anxiety of the end user as well as eliminate a large number of calls to the Command Center during the "Go Live" period
    j. With an organized and thorough Integrated Testing period, the actual first productive use of the system and subsequent days of the "Go Live" period are likely to be a "boring," nonevent
    k. Feedback from the end users and administrative staff will help determine how long the Command Center will need to be staffed on a 24 hour a day basis
        (1) The command center is set up and ready to coordinate all issues, concerns and "Go Live" Help Desk functions

  - **(2)** The Command Center has a sufficient number of phone lines and beepers to support the move to the Live, production environment
  - **(3)** For a period of time, this will include 24-hours-a-day operations
  - **(4)** Often, the representatives/consultants of the new software company are on-site to assist with "Go Live" support and staffing of the Command Center
  - **(5)** The advantages of having designated command center include close proximity of clinical, administrative, technical and vendor team members to quickly assess and prioritize issues
  - **(6)** This close proximity also allows rapid communications and trending of problems in near real time during the first days of the new system's use
  - **(7)** Team members, trainers and super users serve as resources to the end users on a 24-hour basis during "Go Live," often a period of 1–2 weeks

3. Evaluation Post-Live
- **a.** The important tasks of Evaluation are
  - **(1)** Collection of post-live Success Criteria
  - **(2)** Completion of a System/Project Evaluation including the results of the Success Criteria
  - **(3)** Transitioning end-user support from the Command Center to the Help Desk
  - **(4)** Closure of the project
- **b.** The system is evaluated to determine whether it has accomplished the Project Scope's stated objectives
  - **(1)** It involves a comparison of the working system with its functional requirements to determine how well the requirements are met, to determine possibilities for growth and improvement, and to preserve the lessons learned from the implementation project for future efforts
  - **(2)** The Post "Go Live" evaluation describes and assesses, in detail, the new system's performance
  - **(3)** Utilizing the criteria established in Planning Phase, the evaluation process summarizes the entire system, identifying both the strengths and weaknesses of the implementation process
  - **(4)** Comparison of the pre- and post-implementation Success Criteria data provide quantitative data as to the successes obtained with the new system
  - **(5)** The evaluation often leads to system revisions and, ultimately, a better system
- **c.** To evaluate an implemented hospital information system, many principles are important
- **d.** This evaluation component becomes a continuous phase in total quality management
- **e.** The system is assessed to determine whether it continues to meet the needs of the users
- **f.** The totally implemented system will require continuous evaluation
  - **(1)** To determine if upgrading is appropriate
  - **(2)** And/or what enhancements could be added to the current system
- **h.** Formal evaluations generally take place no less than every 6 months and routinely every 2–4 years after the system have been implemented
- **i.** The formal evaluation can be conducted by an outside evaluation team to increase the objectivity level of the findings
- **j.** Informal evaluations are done on a weekly basis
- **k.** Other approaches to evaluating the functional performance of a system exist
- **l.** System functional performance can be assessed by examining nurses' morale and nursing department operations
- **m.** Documentation of care must be assessed if patient care benefits are to be evaluated
- **n.** The following questions should be asked
  - **(1)** Does the system assist in improving the documentation of patient care in the patient record?
  - **(2)** Does the system reduce patient care costs?
  - **(3)** Does the system prevent errors and save lives?
  - **(4)** To evaluate nurses' morale requires appraising nurses' satisfaction with the system. The following questions may be considered useful:
  - **(5)** Does the system facilitate nurses' documentation of patient care?
  - **(6)** Does it reduce the time spent in such documentation?
  - **(7)** Is it easy to use?
  - **(8)** Is it readily accessible?
  - **(9)** Are the display "screens" easy to use?
  - **(10)** Do the displays capture patient care?
  - **(11)** Does the system enhance the work situation and contribute to work satisfaction?
- **o.** To evaluate the departmental benefits requires determining if the CIS helps improve administrative activities
- **p.** The following questions must be answered
  - **(1)** Does the new system enhance the goals of the department?
  - **(2)** Does it improve department efficiency?
  - **(3)** Does it help reduce the range of administrative activities?
  - **(4)** Does it reduce clerical work?
- **q.** Other criteria are necessary to evaluate technical performance; these include reliability, maintainability, use, response time, accessibility, availability, and flexibility to meet changing needs.
- **r.** These areas are examined from several different points
  - **(1)** The technical performance of the software
  - **(2)** As well as hardware performance
- **s.** The following questions must be answered
  - **(1)** Is the system accurate and reliable?
  - **(2)** Is it easy to maintain at a reasonable cost?
  - **(3)** Is it flexible?
  - **(4)** Is the information consistent?
  - **(5)** Is the information timely?

    (6) Is it responsive to users' needs?
    (7) Do users find interaction with the system satisfactory?
    (8) Are input devices accessible and generally available to users?

Teaching Tip
Provide the following information, implementation of a clinical system is a project. By definition a project has a beginning, a middle, and an end. The transitioning of the end-user support functions from the Command Center to the Help Desk, and submission of the Post-Live Evaluation to the Steering Committee are particularly important events in determining the end of an implementation project and the beginning of the maintenance and growth phases of the new system.

4. Daily support operations
    a. Daily support operations begin during the Go Live period. "Help Desk" functions for recording and tracking end-user calls/tasks for help are often managed by the Go Live team in the Command Center during the first 1–3 weeks post-live
    b. Daily meetings/huddles are held with the Go Live team and IT Help Desk staff to review both type and frequency of problems encountered by the end users
    c. The most frequent type of call during the Go Live period are from users unable to log into the system
    d. The proactive recommendation is to include a task in the Cut Over Plan to assign user logins and have all users log into the new system 2–7 days before Go Live
    e. The second most frequently received calls stem from the user's lack of knowledge on how to complete a specific task
    f. Reinforcement of training through one-to-one interventions as well as via mass communications are done
    g. Early resolution of problems and communication back to staff is imperative and fosters confidence that the Project Team and the organization are addressing their needs during this stressful period
5. Ongoing maintenance
    a. The requirement for support resources in the hospital/healthcare environment is a challenge for organizations
    b. Many organizations utilize technical, analyst, and nursing informatics resources to provide the 24/7 support coverage
    c. Strong communication and issue/task resolution procedures assist in responding to user needs
    d. The technical manager reviews requirements for networks, servers, hardware, and certain software concerns
    e. Commercial software companies continue to provide upgrades and updates to their systems/applications
    f. Ongoing review of new features and functions, federal and state requirements, insurance and billing requirements occur
    g. Nursing Informatics personnel must bridge the support of the basic system requirements with the fast paced release of new technologies used in patient care
    h. The cost of purchase and implementation is high
    i. Maintaining and improving the system's ability to support all aspects of patient care delivery is mandatory
    j. To upgrade a system, the same phases and activities described for the SLC must occur
    k. However, when upgrading, dovetailing the changes into the current system will require close evaluation and planning

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- This chapter describes the process of designing, implementing, and/or upgrading a clinical information system/EHR in a patient healthcare facility
- It outlines and describes the four phases of the SLC process
    - Planning
    - System analysis
    - System design, development, implementation
    - And evaluation and system maintenance and support
- The upgrading process reviews all of the components described to assure a
    - Technically sound
    - Regulatory complete implementation supporting safe patient care
    - And streamlined workflow
- A clinical system/ EHR implementation checklist, utilizing the SLC process has been developed

Teaching Tip
Refer to Figure 11.8.

- The planning phase
    - Determines the problem scope
    - And outlines the entire project
    - To determine if the system is feasible and worth developing and/or implementing
- The analysis phase assesses the problem being studied through extensive data gathering and analysis
- The design phase produces detailed specifications of the proposed system
- Development involves
    - The actual preparation of the system
    - Support of workflow
    - Review of policies and procedures impacted by the new system
    - And detailed implementation planning

- Testing is generally conducted on three levels for both
    - The design
    - And implementation of a commercially available system
- Training focuses on the use of the system to improve their everyday workflow
- Implementation outlines the detailed plans for moving the new system into the production or live environment
- Evaluating the system determines the positive and negative results of the implementation effort and suggests ways to improve the system
- Upgrading the system involves expansion or elaboration of initial functions by expanding capability or function or by adding entirely new applications
- Upgrading projects require all implementation phases be reviewed to assure success

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe a methodology and checklist for the phases of a system implementation life cycle
- Describe barriers and critical success factors related to implementation
- Describe the Nursing Informaticist role in a clinical system's implementation life cycle
- Discuss the heightened impact of regulatory and financial requirements on the Electronic Health Record (EHR)

Teaching Tip

Ask the students to define the keywords

- Project scope
- Request for Proposal (RFP)
- Request for Information (RFI)
- Workflow analysis
- Workplan
- Feasibility study
- Go Live plan
- Communication plan
- Issues list

CHAPTER REVIEW QUESTIONS

Question 11.1: What are the four major phases of the System Life Cycle?

a. Analysis, Design, Develop and Customize, Project Management, and Implement, Evaluate, Support and Maintain

b. Project Management, Planning, and Analysis, Implement, Evaluate, Support and Maintain

c. Planning, Analysis, Implement, Evaluate, Support and Maintain, and Project Management

d. Planning, Analysis, Design, Develop and Customize, and Implement, Evaluate, Support and Maintain

Question 11.2: What are the major activities included in the Planning Phase of a SLC?

a. Develop Project Governance and Staff, Determine Project Scope, Conduct Feasibility Study, and Determine Resource Planning

b. Determine Project Scope, Develop Maintenance Manual, Conduct Feasibility Study, and Determine Resource Planning

c. Develop Maintenance Manual, Conduct Feasibility Study, Determine Project Scope, and Determine Resource Planning

d. Develop Maintenance Manual, Develop Training Materials, Determine Scope of Project, and Conduct Feasibility Study

Question 11.3: What is the purpose of the Feasibility Study?

a. Is an analysis to only study the technical issues for the proposes SLC

b. Is a preliminary analysis to determine if the proposed problem can be solved by the implementation of the EHR

c. Is a research study to analyze the resources needed for the SLC

d. Is a computer application to determine what software is needed for the SLC

Question 11.4: Which activity is the major goal of the Analysis Phase of a SLC?

a. The Major Purpose of the Analysis Phase of the SLC is to only determine staffing requirements

b. The Major Purpose of the Analysis Phase of the SLC is to only determine hardware and software requirements

c. The Major Purpose of the Analysis Phase is to determine the "fact-finding" phase- all data needed for the SLC.

d. The Major Purpose of the Analysis Phase of the SLC is to determine workflow representing the logical sequence of the functional data

Question 11.5: Which data collection methods are tools designed to collect reportable data in the Analysis Phase?

a. Questionnaires, Interviews, Software Design, and Functional Design

b. Interviews, Questionnaires, Observations and Workflow Diagrams

c. Observations, Hardware Design, Interviews, and Flow Sheets

d. Written Documents, Interviews, Educational Manual, and Sample Output Reports

Question 11.6: What does the functional design documents consist of?

a. It outlines the human and machine procedures. True ___ False ___

b. It outlines the processing requirements. True ___ False ___

c. It determines the resources required to conduct the SLC. True ___ False ___

d. It uses the workflow documents to determine how the new system will work. True ___ False ___

e. It uses the Project Timeline to develop key milestone events. True ___ False ___

Question 11.7: What are the major activities conducted in the System Design, Development, and Customization Phase?

a. Technical Specification, Networks, Hardware and Software Requirements, and Evaluate System Benefits

b. Functional Specifications, Hardware and Software Requirements, Networks and Develop Training Manual

c. Networks, Functional Specifications, Training Manual, and Evaluate System Benefits

d. Functional Specifications, Technical Specification, Hardware and Software Requirements, and Networks

Question 11.8: Give examples of major plans developed during the Legacy Systems Data Conversions of the System Design, Development, and Customization Phase?

a. Communications Plan, Interface Plan, Conversion Plan, and Testing Plan.

b. Interface Plan, Conversion Plan, and Error Correction Plan.

c. Conversion Plan, and Testing Plan, RFP Plan, and Interface Plan

d. Testing Plan, Conversion Plan, Error Correction Plan and RFP Plan

Question 11.9: What are the major activities conducted during the Implement, Evaluate, Maintain, and Support Plan?

a. Sample Cutover Plan, Vendor Selection, Feasibility Study, and Gap Analysis

b. System Documentation, "Go Live" Plan, Sample Cutover Plan, and End-user Training

c. System Documentation, End-user Training, Feasibility Study, and Vendor Selection.

d. "Go Live Plan," Gap Analysis, End-user Training, and Vendor Selection

Question 11.10: How are some of the documentation of care assessed if patient benefits are to be evaluated?

a. Reduce Patient Care Costs, Nurses' Satisfaction, Project Closure, Prevent Errors, and Easy to Use

b. Easy to Use, Prevent Errors, Reduce Patient Care Costs, Cutover Plan, and Project Closure

c. Readily Accessible, Prevent Errors, Nurses' Satisfaction, Project Closure, and Project Maintenance

d. Easy to Use, Readily Accessible, Prevent Errors, Reduce Patient Care Costs, and Nurses' Satisfaction

ANSWERS AND EXPLANATIONS

Question 11.1: (d) Planning, Analysis, Design, Develop and Customize, and Implement, Evaluate, Support and Maintain. The System Life Cycles (SLC) has been described by various of systems that were implemented on time and within budget. Later they were described by the concepts of the end-users perceptions determining the project success. More recently the systems have been on whether they improved patient safety through evidence-based medicine while meeting federal requirements set forth in the HITECH Act of 2009. Today the SLC refers to the tasks multiple disciplines must accomplish to produce a technically sound, regulatory compliant and user-friendly E H R supporting safe, effective and efficient patient care delivery. The SLC described by the American Nurses Credentialing Center's Nursing Informatics consists of four major phases listed above.

Question 11.2: (a) Develop Project Governance and Staff, Determine Project Scope, Conduct Feasibility Study, and Determine Resource Planning. The first phase of a SLC is the Planning Phase of the project which begins when an organization has determined an existing requirement may be filled by the development and implementation of an EHR. The key Planning Phase activities begin with the establishment of an EHR committee structure. The Strategic goals and priorities must be reviewed to determine the scope of the project including allocating appropriate resources, conducting a feasibility study, project timeline, as well as other project assumption and details.

Question 11.3: (b) Is a preliminary analysis to determine if the proposed problem can be solved by the implementation of the EHR. A Feasibility Study is necessary to conduct a preliminary analysis to determine if the proposed problem can be solved by the implementation of an HER. It not only clarifies the problem and/or stated goal but also helps to identify the information needs, objectives, and scope of the project.

Question 11.4: (c) The Major Purpose of the Analysis Phase is to determine the "fact-finding" phase-all data needed for the SLC. The system analysis phase which is the second phase of developing an HER is the fact-finding phase. All data needs related to the requirements are defined in a project scope agreement. The collection of data reflecting the existing problem or goal is the first step the Analysis Phase. The data collection creates a workflow for the goals, etc.; a gap analysis which compares what is available to what is desired; and any design changes from the old to the new are made. Data analysis and review are critical to formulating the proposal which is generally completed in this phase.

Question 11.5: (b) Interviews, Questionnaires, Observations and Workflow Diagrams. The data collection uses the workflow documentation to organize the data collected into logical sequencing of functions performed by the end users. They are based on the collection of the forms used in day-to-day operations. The major ones listed above are used to complete the workflow document.

Question 11.6:

- **a.** True
- **b.** True
- **c.** False
- **d.** True
- **e.** False

The functional design for the SLC is based on the overview statement of how the New system will work. It uses the workflow documents as its base, and adding critical documentation such as the human machine procedures, the input points, the processing requirements, the output from data entry, and major reports to be generated from the new system.

Question 11.7: (d) Functional Specifications, Technical Specification, Hardware and Software Requirements, and Networks. The third phase of the SLC is the System Design, Development, and Customization Phase, in which the design details to develop the system and the detailed plans for implementing and evaluating the system evolve for both functional and technical components. Data dictionaries are populated, policies and procedures reviewed, requirements for the hardware and software determined as well as many other technical aspects are developed.

Question 11.8: (a) Communications Plan, Interface Plan, Conversion Plan, and Testing Plan. The conversion of data from a Legacy System to a new system is a major area of coordination for the Project's technical manager. The Conversion design from the old to a new system are frequent areas causing project delays. Multiple plans are developed that help to incorporate the Legacy System Conversion implementation workplan include those listed above.

Question 11.9: (b) System Documentation, "Go Live" Plan, Sample Cutover Plan, End-user Training. The last phase of the SLC is the Implement, Evaluate, Maintain, and Support Phase. This phase provides the final product of the SLC. It included the System Documentation. Implementation "Go Live," Sample Cutover Plan, Evaluation Post-Live and Daily Support Operations. The Timing of the conversion activities and activation of the Interfaces require particular coordination between the technical and the project teams.

Question 11.10: (d) Easy to Use, Readily Accessible, Prevent Errors, Reduce Patient Care Costs, and Nurses' Satisfaction. To evaluate the system, many principles are important. It really becomes a continuous phase in total quality management. The system is assessed to determine whether the system continues to meet the needs of the users. It requires assessing staff satisfaction, investigating the functions such as administrative control, charting, management reports, and other tools to assess the systems benefits. They are best assessed through a series of questions which address nurses' appraisals of satisfaction with system.

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12

System and Functional Testing

• OBJECTIVES

1. Differentiate testing and quality assurance.
2. Differentiate testing types related to the system life cycle.
3. Describe testing levels, methodologies, and tools.
4. Examine barriers and success factors related to testing.
5. Discuss roles and skillsets of the informatics nurse in system and functional testing.

• KEY WORDS

Commercial Off-The-Shelf (COTS) system
Unit Testing
Integrated Testing
Usability Testing
Interoperability
Implementation strategy

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: Have you ever tested a product? How did you test the product? Why would it be important to test health information systems? What type of test would be conducted?

For a WIIFM statement, say to the class, "this chapter will focus primarily on testing types and levels that are most commonly employed in the implementation and maintenance of COTS clinical systems; it will also review testing and quality assurance in the context of information technology industry standards." As a nurse, it is important to understand testing of clinical information systems.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Introduction

1. System and functional testing are critical components of the system life cycle, whether the software or system is
   a. Under new development
   b. Or is commercial off-the-shelf (COTS) software that is being configured for a customer's specific needs
2. Testing definitions and goals have evolved over the past 60 years from the most simplistic "bug detection" process, conducted toward the end of the design and coding phases
3. The more contemporary definition goes far beyond bug detection to include
   a. Dimensions of "correctness" and alignment of the technology to the business goals

   - **b.** With the intent that the software does what it is supposed to do
   - **c.** Errors are caught and resolved very early in the development process
   - **d.** Testing includes the business and end-user impacts
4. Testing and quality assurance are not synonymous
5. Testing is composed of activities performed at various intervals during the development process with the overall goal of finding and fixing errors
6. The system life cycle phase usually drives how testing activities are organized
7. The testing plan will normally include coordination of
   - **a.** Test efforts (scheduling resources, preparing scripts and other materials)
   - **b.** Test execution (running prepared test scripts with or without automated tools)
   - **c.** Defect management (tracking and reporting of errors and issues)
   - **d.** A formulation of a test summary
8. Quality assurance (QA) is a proactive, planned effort to ensure that a defect-free product fulfills the user-defined functional requirements
9. Testing is an indispensable tool
10. Testing represents the most reactive aspect of the quality assurance process
11. Testing is all about finding defects
12. Quality assurance is all about preventing defects
13. In theory, an exceptional QA process would all but eliminate the need for bug fixing
14. QA is utilized widely in the broader information technology industry to help guarantee that a product being marketed is "fit for use"
15. Many—perhaps even most—healthcare organizations rely on testing alone
16. Quality assurance can be best envisioned as an integrated approach, composed of test planning, testing, and standards

Teaching Tip
Refer to Figure 12.1: Testing and Quality Assurance.

17. Test planning activities include
   - **a.** Requirements analysis—user needs compared to the documented requirements
   - **b.** Ambiguity reviews—identify flaws, omissions, and inconsistencies in requirements and specifications
   - **c.** Non-redundant test script design—all key functions are tested only once in the scripts
   - **d.** Creation of test data—the right kinds of test patients and data to test all functions
   - **e.** Problem analysis—defect management includes uncovering underlying issues
   - **f.** Coverage analysis—the scripts will test all key functions, and all key nonfunctional components and features
18. Standards, the third element of quality assurance, involves
   - **a.** The creation and enforcement of testing standards
   - **b.** Process improvement activities related to QA
   - **c.** Evaluation and appropriate use of automated testing tools
   - **d.** Quality measures (application of effectiveness metrics to the QA function itself)
19. Software quality assurance is a planned effort to ensure that a software product fulfills verification and validation testing criteria and additional attributes specific to the project, for example, portability, efficiency, reusability, and flexibility
20. This chapter will
   - **a.** Focus primarily on testing types and levels that are most commonly employed in the implementation and maintenance of COTS clinical systems
   - **b.** It will also review testing and quality assurance in the context of information technology industry standards

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Testing Models and Methodologies

1. Testing models have evolved in tandem with the ever-increasing complexity of healthcare software and systems
2. Early software development models were derived from Deming's Plan-Do-Check-Act cycle
3. The Waterfall model
   - **a.** Characterized by relatively linear phases of design, development, and testing
   - **b.** Detailed definition of end-user requirements, including any desired process redesign, flowed to logical design (data flow, process decomposition, and entity relationship diagrams), which flowed to physical design (design specifications, database design), then to unit design, and ultimately to coding (writing in a programming language)
   - **c.** Testing occurred toward the end of the Waterfall development model—a bit late for any substantive code modifications
   - **d.** This Iterative software development model employed cyclical repeating phases, with incremental enhancements to the software during each define-develop-build-test-implement cycle
   - **e.** The main advantage of an iterative approach was earlier validation of prototypes, but the costs of multiple cycles were often prohibitive
   - **f.** As software development models evolved, testing levels were correlated with the Waterfall technical development phases to demonstrate how development phases should inform the testing plan and how testing should validate the development phases

Teaching Tip
Refer to Table 12.1: V-Model.

4. Agile software development, in contrast to some of the earlier models, is characterized by nearly simultaneous design, build, and testing
    a. Extreme Programming (XP) is a well-known Agile development life cycle model that emphasizes end-user engagement. Characteristics include
        (1) Generation of business stories to define the functionality
        (2) On-site customer or end-user presence for continual feedback and acceptance testing
        (3) Programmer-tester pairs to align coding with testing—and in fact, component test scripts are expected to be written and automated before code is written
    b. Integration and testing of code are expected to occur several times a day
    c. Simplest solution is implemented to solve today's problems
5. Scrum is a project management method that accelerates communication by all team members, including customers or end users, throughout the project
    a. A key principle of Scrum is the recognition that customers are likely to change their minds about their needs (requirements churn)
    b. Scrum approaches requirements churn as an opportunity to respond quickly to emerging requirements and to better meet the business needs of the customer
    c. The Agile software development–Scrum project management model
        (1) Encompasses some key quality assurance principles
        (2) Is adaptable to healthcare information technology COTS implementation projects
        (3) And the intense end-user participation almost guarantees the end product will be "fit for use"

Testing Strategy and Process

1. Broad goals for health information technology system and functional testing include
    a. Building and maintaining a better product
    b. Reducing costs by preventing defects
    c. Meeting the requirements of and maintaining credibility with end users
    d. Making the product fit for use
2. Failure costs in system development may be related
    a. To fixing the product
    b. To operating a faulty product
    c. And/or to damages caused by using faulty product
3. Resources required to resolve defects may start with programmer or analyst time at the component level, but in the context of a clinical information system thought to be "ready for use," defect resolution includes multiple human resources
    a. Testing analysts
    b. Interface analysts
    c. Analysts for upstream and downstream applications
    d. Analysts for integrated modules
    e. Database administrators
    f. Change management analysts
    g. Technical infrastructure engineers
    h. End users of the new system and up- and downstream interfaced systems
    i. And others
4. Unplanned fix-validate cycles
    a. Require significant additional computer resources
    b. May impact project milestones with deleterious cascading effects on critical path activities and the project budget
5. Operating a faulty software product incurs unnecessary costs in computer resources and operational efficiencies, and potential damages include
    a. Patient confidentiality violations
    b. Medical errors
    c. Data loss
    d. Misrepresentation of or erroneous patient data
    e. Inaccurate aggregated data
    f. Lost revenue
6. There may be also costs associated with loss of credibility
7. An inadequately tested system that fails "fit for use" criteria will negatively, perhaps irreparably, influence end-user adoption

Teaching Tip

Provide the example. A testing plan is as indispensable to a clinical system project as an architect's drawing is to a building project.

You wouldn't try to build a house without a plan—how would you know if it will turn out "right"?

8. Test planning should
    a. Begin early in the system life cycle
    b. Align closely with business and clinical goals
9. Project definition and scope, feasibility assessments, functional requirements, technical specifications, required interfaces, data flows, workflows and planned process redesign, and other outputs of the planning and analysis phases become the inputs to the testing plan
10. Technological constraints of the software and hardware and the ultimate design configuration to support the workflows represent additional inputs to the testing plan
11. Testing predictably takes longer than expected
12. The testing timeline is often the first project milestone to be compressed
13. It is advisable to plan for contingency testing cycles
14. Depending on the complexity and magnitude of a COTS system implementation, three or more months should be reserved for testing in the project timeline

Teaching Tip

Refer to Figure 12.2 (Testing Timeline Example) as it depicts a testing timeline for multiple concurrent projects, and reflects varying scope and complexity of the projects.

System Elements to be Tested

1. Commonly tested clinical system elements include
    a. Software functions or components
    b. Software features
    c. Interfaces
    d. Links
    e. Devices
    f. Reports
    g. Screens
    h. User security and access
2. Components and features include
    a. Clinical documentation templates and tools
    b. Order and results management functions
    c. Clinician-to-clinician messaging
    d. Care plans
    e. Alerts and reminders based on best care practices
3. Testing of the documentation features should, at minimum, include the capture of clinical data and how the data are displayed in the system
    a. Are the data elements non-redundant?
    b. Are the data captured during a clinical documentation episode displayed correctly, completely, and in the expected sequence in the resulting clinical note?
    c. Are discrete data elements captured appropriately for secondary use, such as for building medication, allergy, immunization, and problem lists, driving clinical alerts and reminders, and populating operational and clinical reports?
    d. Can clinicians and others, such as ancillary department staff, billing staff, and auditors, easily find recorded data?
    e. Can the user add data and modify data in the way expected in that field—structured coded values versus free text, for example?
    f. Once accepted, can data be deleted or modified with a version trail that is visible to an end user?
    g. Do the entered values show up in the expected displays?
4. System outputs to test include printing, faxing, and clinical messaging
    a. Do test requisitions, patient education and clinical summaries, and letters print where they are supposed to print?
    b. Are prescriptions for scheduled medications printing on watermarked paper, if required?
    c. Do the documents print in the right format, and without extra pages?
    d. Faxing is important to thoroughly test, to prevent potential violations of patient confidentiality?
    e. The physical transmission is tested to ensure that it gets to the correct destination and includes all required data, formatted correctly, and inclusion of contact information in case a fax gets to the wrong recipient?
    f. Testing should also include the procedures that ensure fax destinations are periodically verified?
5. Order entry and transmittal testing occur at several levels
    a. The simplest level of testing is unit testing: does each orderable procedure have the appropriate billing code associated?
    b. Are all orderables available to ordering providers in lists or sets, via searches, and are the orderables named in a clinically identifiable and searchable way, including any abbreviations or mnemonics?
    c. Does each order go where it is supposed to go and generate messages, requisitions, labels or other materials needed to complete the order?

Teaching Tip

Provide the following example, an order entered into the electronic health record for a laboratory test on a blood specimen collected by the ICU nurse generates an order message that is transmitted into the laboratory information system, and may generate a local paper requisition or an electronic message telling the nurse what kind and how many tubes of blood to collect, as well as generating specimen labels. These outputs for a nurse-collected lab specimen order are tested, as well as the outputs for the same ordered lab specimen collected by a phlebotomist.

    d. At the integrated level of testing, the order message and content received in the laboratory information system (LIS) is reviewed for completeness and accuracy of the display—does the test ordered exactly match the test received?
    e. Does the result value received from the LIS display correctly, with all expected details, such as the reference ranges and units, collection location, ordering provider, and other requirements?
6. Interface testing includes system modules, external systems, medical devices, and file transfers
    a. Interfaces are tested for messaging and content, data transformation, and processing time
    b. Interface data flows may be unidirectional or bidirectional
    c. System module interfaces include admission/discharge/transfer (ADT), clinical documentation, order entry and results management, document management, patient and resource scheduling, charge entry and editing, coding, claims generation and edit checking, and other major functions
    d. A data conversion from one system to another system is also a type of interface
    e. Data dictionary testing is vital
    f. In a fully integrated clinical system, the master files for data elements may be shared, so a change to the metadata in a master file needs to be tested for unintended impacts across modules
    g. Other clinical systems may have redundant master files within multiple modules
    h. Testing plans should ensure that the data elements are synchronized across the modules and interfaced systems
    i. Data conversion testing must ensure that the data being converted from one system will populate the new system accurately

   j. This often requires multiple test cycles in non-production environments to test each component of each data element being converted, prior to the actual conversion into the live production environment
7. Clinical system testing includes links to third-party content for patient education, clinical references, and peer-reviewed evidence, coding support systems, and others
   a. Links to Web content resources for clinicians, including software user support, can be embedded into the software in multiple locations
   b. These links should be tested in every location to ensure that they work properly and bring the user to the right content
8. Medical device interfaces include invasive and noninvasive vital signs monitoring, oximetry, wired and wireless cardiac monitoring, hemodynamic monitoring, ventilators, infusion pump integration, urimetry monitoring, and other devices
   a. Middleware can be used to acquire the data and provide the nurse with an interim step of validating data before accepting it into the clinical system
   b. Newer medical devices include wireless continuous vital signs monitoring worn in the hospital or at home, nurse call systems, and bed or chair fall alarm systems
   c. Testing outcomes for medical devices should consider data validation and alert or alarm risk mitigation steps
   d. Data validation refers to the accurate capture of physiologic and device data, such as blood pressure and concurrent pump infusion rate, such as the dose of a vasopressor, and requires the nurse to review and accept or reject the data
   e. Alerts and alarms for data captured into the clinical system must be thoroughly tested for relevant settings, such as range and sensitivity
   f. It is critical to minimize false alarms, which may result in alert fatigue, yet still alert nurses and other clinicians to genuine patient status changes
9. Reports testing should be performed at multiple levels
   a. Reports may be static or dynamic

Teaching Tip
Provide the example of static reports which include the formatted display of a documentation episode, specialized displays that pull in data from multiple modules within the clinical system, requisitions that are generated from orders, and the multiple report types that are generated from a data warehouse and may be linked to the clinical system.

   b. Data warehouse reports typically contain day-old data
   c. The reports are intended to support individual clinical decision making as well as provide snapshots of population-level information used for trending, quality improvement, operational assessment, and various external reporting requirements
   d. Dynamic reports (using "real-time" data) provide clinical and operations staff with current information on individual or aggregated patients, and can be updated real-time

Teaching Tip
Provide the examples of dynamic reports which include patient lists or registries, appointment no-shows, and queries relevant to a provider ("all of my patients that have a statin prescription") or nurse ("all of my heart failure patients").

   e. Report testing includes the formatting, accurate inclusion of required data, but also comparing the source data to the data in the reports

Teaching Tip
For example, a CCHIT-certified electronic health record is capable of producing a CCD document to meet health information exchange standards, but there are differences among the vendors and among data dictionaries, and testing ensures that the data elements are populating values to the CCD document correctly.

10. User security and access can make or break go-live success
   a. User access is designed to be role-based
   b. Each user role has specific functions and views associated

Teaching Tip
Provide the example, a physician requires the ability to order tests and procedures including referrals and consults, e-prescribe, document with tools tailored to specialty as well as electronic medication administration and reconciliation, update problem lists and allergy lists, view customized displays of data, query data real-time, calculate and submit professional charges, generate health information exchanges, among other functions.

The nurse role requires specified documentation activities, some of which may be required, and will usually incorporate a subset of physician functions. Nursing activities generally depend on the location of care. Hospital nurses generally do not have full ordering privileges, but can enter orders under protocol, and some of those orders require physician co-signature. Hospital nurses may or may not be able to update the patient's problem list, per the organization's policy, but typically can update allergy lists and prior-to-admission medication lists.

   c. The security needed for ordering can be different in an ambulatory clinic setting, where physicians may delegate some ordering tasks, and advanced practice nurses practice independently
   d. For an enterprise-wide electronic health record, practice scope differences must be thoroughly tested to ensure that each clinician has the right access in the right care location
   e. Testing should also include what the person in that role should not be able to perform, such as a hospital registrar ordering medications
   f. This is sometimes termed "negative testing"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Testing Types

1. Testing types used vary based on where in the system life cycle testing is planned, and the degree of development or programming that is involved

Teaching Tip
Refer to Table 12.2 as it describes common testing types suggested, based on magnitude, for development of the testing plan.

2. The first step in test planning is to define what is to be accomplished
3. The goals should include the
   - **a.** Scope
   - **b.** Expectations
   - **c.** Critical success factors
   - **d.** Known constraints, which will be used to shape the rest of the plan
4. Testing approach defines the "how" and includes the following:
   - **a.** The techniques or types of testing
   - **b.** The entrance and exit criteria
   - **c.** Defect management and tracking
   - **d.** Feedback loop with development
   - **e.** Status and progress reporting
   - **f.** Perhaps most importantly, exceptionally well-defined requirements as the foundational component
5. The environment for testing defines the physical conditions
   - **a.** End-user hardware to be included in testing (desktops, laptops, wireless workstations, tablets, smartphones, thick client, thin client, scanners, printers, e-signature devices, and other)
   - **b.** The interface to be included
   - **c.** The test environment for the application and other systems to be tested
   - **d.** Automated tools
   - **e.** Type of help-desk support needed
   - **f.** And any special software or system build required to support testing
6. Multiple test-user roles are needed for testing to assure appropriate role-based tools, functions, and views
   - **a.** Test patient records are created so that age- and gender-appropriate documentation tools and decision support, including alerts and reminders, are tested
   - **b.** Laboratory values and other diagnostic results for test patients can be manually built into the test system, or copied over from a real patient without identifiers, to allow testing of expected results-driven decision support, flags, displays, and temporal views such as graphs and charts
7. Next, testing specifications are developed that define format standards, identify features to be tested, cross-reference features to the functional requirements, and break down the work into manageable pieces
   - **a.** The testing team documents how each feature will be tested, existing interdependencies, and the test workflows, which will be devised to include all of the required test specifications, but in efficient and non-redundant flows that usually will not match end-user workflows
   - **b.** Scripts that emulate end-user workflows are usually utilized for acceptance testing
8. Scheduling is a vital test planning component, and involves the coordination of multiple human and technical resources
9. Testing requires scheduling many of the technical participants discussed earlier for integrated testing, plus others from the software, infrastructure, vendor, and clinical and business areas
10. Ideally, end users have been involved in all system life cycle phases, including testing
11. Test planning includes scheduled formal user acceptance testing (UAT)
    - **a.** Testers should work together in the same location
    - **b.** Often requiring equipment setup for workstations, printers, scanners, electronic signature devices, medical devices, and other peripheral equipment needed for end-to-end testing scenarios
12. Magnitude and complexity of the system as well as testing goals and deadlines are
    - **a.** Inputs into the number of testing cycles
    - **b.** Resources to be scheduled
    - **c.** Progress checkpoints
    - **d.** Contingency planning
13. The final step in test planning
    - **a.** Is sign-off by stakeholders
    - **b.** A vital checkpoints for review of the goals, requirements, and resources, as well as contingency planning, including "go-no go" decisions
14. A typical testing plan for a COTS system requires that all
    - **a.** Functional modules
    - **b.** Features
    - **c.** Interfaces (upstream and downstream) are unit-tested prior to the first integrated test cycle
15. Three or more integrated test cycles are not uncommon for new implementations or extensive upgrades
    - **a.** A subset of tests would be conducted for smaller system changes
    - **b.** Two weeks of integrated testing plus two weeks for fixes and unit testing are desirable for each cycle, always ending on a test cycle … never ending on a fix cycle
    - **c.** Daily testing status updates are essential to monitor outcomes and the potential need for plan modifications

Teaching Tip
Refer to Figure 12.3: Testing Status Update Example.

16. During the two weeks of integrated testing
    - **a.** New software changes should generally not be introduced
    - **b.** And a "code freeze" may be instituted wherein only the highest priority changes are permitted to reduce unintended ripple effects

1. The testing team works through expected and unexpected outcomes of all scripts and documents in the designated tool
    a. Members of the training team and other analysts may also participate
    b. Programmers/builders typically do not test their own work during integrated testing
    c. Builders inherently want their code to work, and they know how to make it work—and they did that during unit testing
2. Testers want to test for failures
    a. In their attempts to break the system, defects are uncovered that might otherwise have been missed
    b. Defects may include
        (1) Functions that do not work as designed
        (2) Workflow issues that were not identified during requirements definition and workflow analysis
        (3) Unintended effects
3. Defects are usually given a priority
4. The project team should establish definitions for priorities
5. Priority examples include (Douglas & Celli, 2011)
    a. Critical: Significant impact to patient safety, regulatory compliance, clinical workflow, or other aspect, for which no workaround is possible
    b. High: Significant impact to workflow or training or other aspect, for which the resolution effort or the workaround is in itself a major effort and may be high risk
    c. Medium: Impact on workflow or training is noteworthy, but a reasonable workaround exists
    d. Low: Impact on workflow or training is minimal; workaround is not required
6. Defects are communicated back to the programmers/builders, and are followed through to resolution using a defect tracking tool
7. These cycles repeat until all critical and high defects, at minimum, are resolved
8. Contingency planning should allow for additional testing cycles
9. The testing plan usually culminates in regression and user acceptance testing
10. Regression testing ensures that fixes implemented during the integration cycles didn't break something else
11. Acceptance testing allows users to validate that the system meets their requirements, and is usually conducted using scripts that reflect redesigned processes from the workflow analysis phase
12. User acceptance testing ideally occurs
    a. After successful integrated and regression testing cycles are completed
    b. Prior to the start of training to avoid the risk of changes that necessitate retraining
    c. UAT should represent a final validation of "fit for use," but not a "surprise" to end users
13. Alpha and/or beta testing may be scheduled when a software or system is newly developed, and both mimic real-world use
    a. Healthcare organizations tend to avoid alpha and beta software because the cost of resources to test immature systems typically outweighs the benefit
    b. Alpha testing is usually conducted in a simulated fashion
    c. Beta testing is more apt to be conducted in a live setting
    d. Both testing strategies can include parallel testing, wherein the users are performing dual data entry—entering data in the new system and in the old system (electronic or paper) to determine whether all required functions exist under normal conditions of use, and the system outputs are as expected
    e. Parallel testing may be more useful for ensuring appropriate charges are generated or other billing-related functions than for clinician workflow testing, such as "shadow charting"
14. Usability and safety are valuable barometers for evaluating testing success
    a. The International Organization for Standardization defines usability in terms of a user performing a set of tasks effectively, efficiently, and with satisfaction, and includes learnability, error frequency, and memorability aspects of the user experience (Rose et al., 2005), with special focus on an attractive user interface that is easy to understand and navigate
    b. Usability's broadest definition, "quality in use," includes the user and task dimensions along with the tool and the environment (Yen & Bakken, 2012)
    c. Usability testing ideally begins early in the design phase and is conducted throughout the system life cycle, through optimization and maintenance as well as during implementation
    d. A HIMSS Task Force developed a usability testing tool

Teaching Tip
Refer to Figure 12.4 which demonstrates the tool adapted for an implementation.

    e. Iterative usability evaluations by actual users could be expected to enable the clinical system to better meet user efficacy and patient safety goals
    f. Technology-induced errors are on the rise, and usability factors, such as small or very dense displays and lack of data visibility, may be related to higher error rates
    g. Information overload related to the sheer quantity of digital data is compounded by organization and display of data that fails to support pattern recognition and other cognitive tasks
    h. User interface design factors contribute to technology-induced errors, and data displays related to a specific user task should be an integral component of testing plans
    i. Data integrity failures in EHRs and other HIT systems are among the top 10 technology hazards for 2014, citing the following contributing factors:
        (1) Patient/data association errors—patient data associated with another patient's record
        (2) Missing data or delayed data delivery
        (3) Clock synchronization errors

    (4) Inappropriate use of default values
    (5) Use of dual workflows—paper and electronic
    (6) Copying and pasting of older information into a new report
    (7) Basic data entry errors, which now can be propagated much farther than could have occurred in paper records

  j. Safety testing incorporates the people, process, technology, environment, and organization-related issues identified in the literature, with a focus on provider order entry, clinical decision support, and closed-loop (bar-coded) medication administration

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Challenges and Barriers

1. Resources, timeline pressures, and materials comprise the most common barriers to sufficient testing
2. Liberating end users from their regular work for testing can prove difficult

Teaching Tip
Provide the example. Liberating end users from their regular work for testing can prove difficult especially in understaffed nursing environments. Direct care clinicians with varying computer skill levels, not just trainers or nursing "early adopters," are essential to include in testing as they represent a realistic cross section of users. This approach produces significant budgetary impacts due to the costs of back-filling staff to be "out-of-count," including overtime and/or temporary staffing costs. The staffing crisis may be exacerbated if training is allowed to overlap testing cycles. Costs may be balanced by benefits in going live with a fully tested and well-vetted clinical system that enables nurses and the care team to be efficient and effective in care delivery, and satisfied with the system.

3. Timeline pressures constitute a universal barrier to sufficient testing
    a. Extending a project timeline to accommodate additional testing adds cost
    b. Pressure to attain project milestones may tempt even the most seasoned project managers to shorten test cycles or use testing shortcuts, though the costs of failure may outweigh costs of timeline changes
4. A third major barrier to testing success is inadequate script development
    a. Testing scripts for integrated testing cycles are typically non-redundant, and do not closely emulate a particular clinical workflow—this is efficient and very appropriate, and an ideal test script could be successfully run by a random person off the street
    b. However, user acceptance testing requires detailed scenario-driven scripts that simulate real workflows
    c. These more detailed scripts will be continually updated throughout the system life cycle, as clinicians provide feedback on nuances of use cases that may have been overlooked
    d. These nuances are valuable findings prior to go-live to close safety gaps and avert potentially inefficient or even unsafe workarounds—nurses can be very creative

Teaching Tip
Provide the example, nursing informatics experts can play key roles in the testing process. Informatics nurses can help to make the case for sufficient testing by tying testing outcomes back to the original project goals for adoption and care improvements, including quantification of costs of clinical adoption failures, patient safety issues, and inability to meet efficiency and effectiveness targets. Informatics nurses can help to develop and execute testing plans and scripts, ensuring that appropriate use cases are iteratively documented for testing that will continue into the system optimization and maintenance phase. Informatics nurses play a valuable role in ensuring data validation across disparate systems. Evaluation of testing effectiveness, usability, and user acceptance are key skills that informatics nurses bring to testing. Informatics nurses also bring value through research.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- The Nursing Informatics International Research Network conducted a recent survey to identify nursing informatics research priorities
    - Development of systems that provide real-time safety-related feedback to nurses, systems impact on nursing care, nursing decision support systems, and systems workflow impacts were the top-ranked international research priorities
- These aspects
    - Are very tactical and close to nursing practice
    - Have implications for various types of system and functional testing
- In summary
    - System and functional testing are critically important to successful implementation and maintenance of clinical information systems
    - Informatics nurses have a responsibility to inform, champion, and evaluate testing processes and outcomes

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Differentiate testing and quality assurance
- Differentiate testing types related to the system life cycle
- Describe testing levels, methodologies, and tools
- Examine barriers and success factors related to testing
- Discuss roles and skillsets of the informatics nurse in system and functional testing

Teaching Tip

Ask the students to define the keywords

- Commercial off-the-shelf (COTS) system
- Unit testing
- Integrated testing
- Usability testing
- Interoperability
- Implementation strategy

CHAPTER REVIEW QUESTIONS

Question 12.1: What best describes the critical components of the system life cycle?

a. Evaluating testing processes and testing outcomes of a system life cycle

b. System and functional testing for the implementation and maintenance of a system life cycle

c. Software testing that is being configured for a system life cycle

d. Quality assurance testing that is proactive to ensure a defective free system life cycle product

Question 12.2: What depicts the purpose of the system and functional testing of a system life cycle?

a. Testing of "bug detection" process of the hardware

b. Testing of the alignment of the technology with business/patient goals

c. Testing of the intent of innovative software

Question 12.3: What are examples of the major test planning activities highlighted in the integrated approach of quality assurance?

a. Ambiguity Reviews, Bug Fixing, Problem Analysis, and Coverage Analysis

b. Problem Analysis, Requirements Analysis, Bug Fixing, and Ambiguity Reviews

c. Requirements Analysis, Ambiguity Reviews, Problem Analysis, and Coverage Analysis

d. Bug Fixing, Coverage Analysis, Requirements Analysis, and Problem Analysis

Question 12.4: Which are the major System and/or Functional Testing Models?

a. Bug Detection, Testing Plan, System Outputs, and Waterfall Development

b. Waterfall Development, Bug Detection, Agile Development Life Cycle, and Scrum Method

c. Agile Development Life Cycle, Scrum Method, System Outputs, and Bug Detection

d. Testing Plan, Bug Detection, System Outputs, Scrum Method, and Bug Detection

Question 12.5: What are examples of inputs to a Testing Plan which is as indispensable to a clinical system project as an architect's drawing is to a building project?

a. Feasibility Assessments, Technical Specifications, Data Flows, and Planned Process Redesign

b. Feasibility Assessments, Technical Specifications, Resource Testing, and Planned Process Redesign

c. Feasibility Assessments, Data Flows, Planned Process Redesign and Resource Testing

d. Technical Specifications, Resource Testing, Data Flows, and Planned Process Redesign

Question 12.6: Elements of a system to be tested address primarily Software Functions, Components, or Features.

a. Common tested elements include Software Functions or Components. True ___ False ___

b. Testing of the Documentation Features include only Clinical Messaging. True ___ False ___

c. Testing of System Outputs includes Printing, Faxing, and Clinical Messaging. True ___ False ___

d. Order Entry and Transmittal Testing includes several levels such as Does Procedures have appropriate billing code? True ___ False ___

e. Interface Testing does not test for data transformation. True ___ False ___

Question 12.7: List some Testing Types examples based on where the System Life Cycle Testing is Planned and the Degree of Development or Programming Involved?

a. Examples of Testing Types can include, Software Testing, Testing Approach, the Environment for Testing, and Interfaces

b. To Define what is to be Accomplished, Testing Approach, Software Testing, and the Environment for Testing

c. Interfaces Included, Testing Approach, Interfaces Included, and Special Software

d. To Define what is to be Accomplished, Testing Approach, the Environment for Testing, and Interfaces Included

Question 12.8: What are the key features of scheduling as a vital test planning component?

a. It involves: Scheduling of the Technical Participants, Scheduling Formal User Acceptance, Scheduling Testing Cycles, and Stakeholder Sign-off

b. It involves: Coordination of Multiple Human and Technical Resources, Scheduling the Technical Participants, Scheduling Formal User Acceptance, and Scheduling Testing Cycles

c. It involves: Coordination of Multiple Human and Technical Resources, Scheduling the Technical Participants, Stakeholder Sign-off, and Scheduling Testing Cycles

d. It involves: Stakeholder Sign-off, Coordination of Multiple Human and Technical Resources, Scheduling the Technical Participants, and Scheduling Formal User Acceptance

Question 12.9: What are examples of the testing for System Failures?

a. Functions that do not work as designed, workflow issues not identified during requirements definitions, and workflow analysis, and Unintended Effects

b. Functions that do not work as designed, workflow issues not identified during requirements definitions, and workflow analysis, and Defect Tracking Tool

c. Functions that do not work as designed, workflow issues not identified during requirements definitions, Unintended Effects, and Defect Tracking Tool

d. Defect Tracking Tool, functions that do not work as designed, workflow issues not identified during requirements definitions, and Unintended Effects

Question 12.10: What are the most common barriers in System and Functional Testing?

a. Resources, timeline pressures, and materials comprise the most common barriers. True ___ False ___

b. Understaffing staffing and other resources. True ___ False ___

c. Liberating end users from their regular work is an asset. True ___ False ___

d. Pressure to attain project milestones. True ___ False ___

e. Inadequate Script development. True ___ False ___

ANSWERS AND EXPLANATIONS

Question 12.1: (b) System and functional testing for the implementation and maintenance of a system life cycle. It is a software that is being configured for a customer's specific needs.

Question 12.2: (b) Testing of the alignment of the technology with business/patient goals. The system and functional testing carries out the intent that software does what it is supposed to do, errors are caught and resolved early in the development process and tested including the impact on the business and end-users.

Question 12.3: (c) Requirements Analysis, Ambiguity Reviews, Problem Analysis, and Coverage Analysis. Quality Assurance is best envisioned as an integrated approach, composed of test planning, testing, and standards.

Question 12.4: (b) Waterfall Development, Bug Detection, Agile Development Life Cycle, and Scrum Method. Testing models have evolved in tandem with the ever-increasing complexity of healthcare software and systems. For example, the testing levels correlated with Waterfall technical development phases to demonstrate how the development phases should inform the testing plans and how testing should validate the development phases.

Question 12.5: (a) Feasibility Assessments, Technical Specifications, Data Flows, and Planned Process Redesign. Testing Plan should begin early in the system life cycle and should align closely with business and clinical goals.

Question 12.6: System Elements to be Tested Address primarily Software Functions, Components, or Features.

a. True

b. False

c. True

d. True

e. False

Question 12.7: (d) To Define what is to be Accomplished, Testing Approach, the Environment for Testing, and Interfaces Included. Common testing types suggested vary based on the magnitude for the development of the testing plan based on the steps listed above.

Question 12.8: (b) It involves: Coordination of Multiple Human and Technical Resources, Scheduling the Technical Participants, Scheduling Formal User Acceptance, and Scheduling Testing Cycles. Testers should work together in the same location, often requiring equipment setup for workstations, printers, scanners, electronic signature devices, medical devices, and other peripheral equipment needed for end-to-end testing scenarios.

Question 12.9: (a) Functions that do not work as designed, workflow issues not identified during requirements definitions, and workflow analysis, and Unintended Effects. Testers who want to test for failures should at least focus on detecting defects. The defects should be given priorities regarding the level of significance, for example, critical, high significant, medium impact, or low impact. They are then communicated to the programmers/builders and are followed through using a defect tracking tool. Such processes should continue until the defects are resolved.

Question 12.10:

a. True

b. False

c. False

d. True

e. True

The barriers are all listed in the question.

13

System Life Cycle Tools

• OBJECTIVES

1. Identify two tools to assist with each phase of the System Life Cycle.
2. Describe two pre- and post-implementation metrics.
3. Describe diagrams that can be utilized for clinical workflow and data workflow.
4. Discuss ways to assess the reporting needs of an organization in relationship to all levels of staff.

• KEY WORDS

Business intelligence
Clinical workflow
Data workflow
Failure Modes and Effects Analysis (FMEA)
Lean methodology
Plan Do Study Act (PDSA)
Process diagram
Systems Life Cycle

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: Have you participated in the selection of a system or device? Can you describe the process? Was the process systematic? Why would it be important to use a systematic process?

For a WIIFM statement, say to the class, "This chapter reviews the stages of the system life cycle and some of the tools available that can be modified to assist with each phase in almost any scenario." As a nurse, it is important to understand the system life cycle.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites regarding content relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OVERVIEW

Introduction

1. Like the nursing process, the system life cycle (SCL) is continuous series of system changes, or evolutions
2. Even after the system is installed, there is
   a. Continuous analysis
   b. Design and implementation of new modules
   c. Upgrades and improvements
3. Nurses are accustomed to leading interdisciplinary teams in the patient care environment
4. Leading interdisciplinary teams for information systems is a natural progression
5. The American Nurses Credentialing Center defines the System Life Cycle as having five phases: System Planning; System Analysis; System Design, Development, and Customization; System Functional Testing; System Implementation, Evaluation, Maintenance, and Support

6. There are variations of these phases
    - a. Some experts include the functional testing in the analysis phase
    - b. And some include the development and customization in the system design phase, for example
7. No matter how they are broken down, each of these phases has specific elements and tools that can aid in the goal of a successfully installed and maintained system that meets the needs of all stakeholders

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Analysis and Documentation of the Current Process and Workflow

1. All phases of the SCL may require analyzing the data and workflow
2. Karsh and Alper describe system analysis and workflow analysis
    - a. As a way to understand how a system works
    - b. And how the different elements in the system interact
3. There are many ways to depict a workflow
    - a. The critical part is the analysis of the process or workflow
    - b. And accurately and completely documenting each step
4. Documenting a workflow may be done by
    - a. Walking through the steps via an intensive interview with those intimately familiar with the process
    - b. By observation
    - c. Or by a combination of the two

Teaching Tip

Provide the following examples, interviewing staff about how a lab or diet order is processed from the time it is entered until it is completed is an example using the interview to document a process. A combination of observation and interviews might be the most effective way to capture all of the nuances for medication administration, and observation alone would be effective for a time and motion study.

5. Analysis provides the data with which you will base decisions that must be made in the design, development, implementation, and evaluation stages of the training project according to Kulhanek
6. A workflow diagram may be done to document the current state when planning for a system implementation
    - a. To identify problems
    - b. Or areas that need improvement
7. A workflow diagram documents the processes of the users
8. The data workflow diagram documents the interaction and flow of the information system(s)
9. There are several types of diagrams that can be utilized to document a process, including
    - a. Swim lanes
    - b. Data flow diagrams (DFDs)
10. A swim lane diagram represents a process
    - a. And is usually grouped in lanes (either columns or rows)
    - b. To help visualize the users or departments involved
11. Workflow can be documented using
    - a. A simple list of the steps in the process
    - b. A swim lane
    - c. Or a workflow diagram
12. No matter what method is used to display the process, it needs to be clear and complete for accurate analysis
13. A simplified process for a diet order might be documented and displayed in the following manner:
    - a. Nursing performs the assessment and documents no known allergies or issues related to swallowing or diet intake
    - b. The provider reviews assessment data and enters the order
        - (1) Nursing reviews the order
        - (2) The order prints in the dietary department
    - c. The diet aide files the order
    - d. The diet prints for the tray line preparation
    - e. The diet is delivered to the unit
    - f. The tray is delivered to the patient

Teaching Tip

Refer to Figure 13.1 which displays an example of the same simplified process for a diet order in a swim lane format.

14. The swim lanes can be displayed in either a vertical or horizontal format
15. Workflow diagrams can be developed using sticky notes rather than a computer program effectively, but transcribing into an electronic display increases the ability to read and share the information

Teaching Tip

Provide the information that more detail on diagrams will be discussed in chapter on Decision Support.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

System Selection and Implementation

1. An information system should support patient care by allowing clinical staff to easily navigate the system to
    - a. Enter information about the system
    - b. Monitor and be alerted to changes
2. Selecting a system that meets the needs of all levels of stakeholders from bedside staff to the executive team is a complicated process with multiple factors involved
3. The TIGER Usability and Clinical Application design team came up with the following attributes of successful implementations
    - a. User and key stakeholder involvement began early in the project with system requirements development and system selection

   - **b.** Clinicians worked with developers to create definitions, wording and graphics that represented workflow process
4. Systems must be easy to use in relation to entering and obtaining data and information
5. Today's clinical systems included
   - **a.** Embedded analytics
   - **b.** Clinical decision support (CDS) to prompt clinicians with warnings and evidence-based suggestions
   - **c.** As well as business intelligence to capture financial and operational data
6. Clinical and Business Intelligence provides historical and predictive perspective of the operations and clinical areas to improve business and clinical decisions
7. Understanding how the different parts of the system work together, as well as how the system will impact the clinical workflow are key elements to consider during the system selection process
8. While having a system that is easy to learn, and use is important, if the data cannot be reported or shared its value decreases significantly

Teaching Tip

Refer to Figure 13.2 as an example of a system diagram, which shows how the Clinical Information System (CIS) relates to other systems required for patient care. For example, the CIS sends reports to the Document Imaging (DI) system, that also stores scanned documents such as a Durable Power of Attorney, which are in turn available in the CIS. The Pharmacy system works with the Bar Code Medication Administration (BCMA) system and Pyxis (Smart pumps thought not displayed here would be another component of medication safety). The financial components that include Accounts Receivable (AR), Registration functions including Admission, Transfer, and Discharge (ADT) send patient information to the CIS, which can send updates, alerts, and requests back. The Lab information System (LIS) may work with an application similar to the barcoding used for drug administration to ensure that the correct tests are drawn, some may also be used for blood administration. Orders may be sent from the CIS to the LIS and Radiology Information System (RIS) that in turn send Order Status Updates (OSU) along with results, reports, and images back into the CIS.

Teaching Tip

For more on System Selection see chapter on Decision Support.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

System Implementation

1. System implementation requires system design and building, and testing
2. System design should involve key stakeholders, especially end users throughout
3. Testing involves making sure that each part of the system works, and that the system works correctly with other modules and systems

Teaching Tip

Refer to Table 13.1 as an example of the unit testing required for a lab interface, whether the LIS, the CIS, or both are being replaced or implemented. Each order needs to be tested from start to finish, so ordered, the OSU received in the CIS when Lab puts the order in progress, and when the preliminary and final results are posted. Each result associated with the order should display correctly (many lab orders, such as a CBC have multiple results associated with them). The charge also needs to be verified for each order.

Teaching Tip

Table 13.2 is an example of a tool that can be used when testing Radiology orders. Like Lab, each order needs to be tested from the time it is ordered through the time it is performed and the final report is posted. Also, being able to display the report and the associated image from the picture archiving and communication systems (PACS) also needs to be verified for each exam. Verification that the appropriate charges drop is also important.

4. Integrated testing is done after unit testing has been accomplished and is the last phase of testing, ensuring that all systems that share data are working correctly in real-life scenarios
5. Similar tools can be used for integrated testing involving interfaced system or, conversion verification to ensure that converted information is correct

Teaching Tip

Refer to Table 13.3 as an example of a tool to verify that the fields related to patient information are correct when being converted from one system to another, or when being interfaced from one system to another. Attention to each field on both displays and printed documents are required. Doing an analysis of each type of admission to make sure a good sampling is done for integrated testing will help assure that testing is comprehensive. Testing needs to include all aspects of the patients' experience, from registration to any testing, documentation, and verification that the bill has dropped correctly.

Teaching Tip

Use as an example, testing fields that are used by multiple applications such as the height (ht), weight (wt), and allergies in Table 13.4 are also important. If both standard and metric values are allowed, both need to be tested. Even though the interfaces were already tested for ancillary departments during unit testing, they need to be tested again during integrated testing. This testing should include any printed notices that are associated with the orders, along with populating work lists and reports as shown in Table 13.5. Each field for each assessment needs to be tested and verified for all displays during unit testing and a large, realistic sampling also needs to be included in the integrated testing. Table 13.6 is an example of assessment testing that includes integration of plan of care and alerts based on the assessments. Any printed documents such as discharge instructions should also be included.

6. Another trend in healthcare is converting not from paper to an electronic record, but from one electronic system to another system
7. Whether this conversion is due to replacing a legacy system, or due to a merger
    a. The complexity of a system conversion brings its own set of requirements in the user expectation
    b. The design and build, testing and the decision of what information to convert
    c. And what to "backload" from the existing system to the new system
8. Backloading, or manually entering information into the new system is often done between 2 and 5 days before a new system is live so that important patient information is available

Teaching Tip

Use Table 13.7 as an example of a report from the legacy system with the information on it. The report may be very accurate, but the information may be outdated before it is printed and distributed, requiring a second, or third report with updated information. The other option is a modification of the report available online, staff doing the backload can either work in pairs, or work off of dual monitors with the legacy system on one monitor and the new system on the other monitor.

9. Stakeholder involvement in a project is improved with regular status reporting
10. Reporting the status of the project from implementation through optimization is critical
11. Stakeholders according to Hanson, Stephens, Pangaro, and Gimbel include
    a. Clinicians
    b. Nurse/ancillary
    c. Patients
    d. Administrators
12. During the implementation
    a. The timeline
    b. Progress
    c. Teams
    d. Schedule for training can be maintained and updated on the intranet
13. Managers and executives might require a more detailed report
14. A general status update can be helpful in visualizing the overall project status

Teaching Tip

Refer to Table 13.8 as an example of a columnar report, and Fig. 13.3 is an example of a chart that depicts the anticipated progress and budget compares it to the actual progress and budget.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

System Optimization and Metrics

1. The system life cycle, like the nursing process is a fluid process of
    a. Assessing
    b. Diagnosis
    c. Planning
    d. Implementation
    e. Evaluation
2. After the system is implemented, the process of system changes does not end
3. System optimization and support
    a. Along with changes due to upgrades
    b. Regulatory and payer changes
    c. As well as clinical changes due to new research all lead to constant changes to the system
4. As stakeholders become more familiar with the system
    a. They will have ideas on improvements and enhancements to make the system more user friendly
    b. As well as improving the ability of the system to prompt staff to improve patient care
5. Along with the process improvement strategies listed below, getting pre- and post-implementation metrics will assist
6. Surveys can be done post implementation to evaluate staff satisfaction with the system, the education, and/or the support
7. Examples of pre- and post-implementation metrics include
    a. Accuracy and completeness of charting
    b. Accuracy and completeness of charging
    c. And time studies
8. The evaluation of charges would include
    a. The timeliness
    b. Accuracy
    c. And whether the charges were supported by the others and the documentation
9. Pre- and post-metrics for charting Core Measures such as vaccinations and education on smoking

Teaching Tip

Use the example, the time to document specific types of charting can be measured and recorded by using a tool similar to Table 13.9.

Measuring Success, Continuing to Improve

1. Continuous Quality Improvement (CQI) is based on the principle that there is an opportunity for improvement in every process
2. CQI begins with a culture of change and improvement
3. CQI encourages all levels of staff to look for ways to improve the current process, and for variations of the process, which can create errors
4. There are many philosophies that can be utilized to implement a CQI program, some can be used in combination

5. Some of these include:
    a. Six Sigma
        (1) Is a "data-driven quality improvement methodology that uses statistical analysis to reduce process variation"
        (2) "Has a strong focus on reducing variation, in fact the term, Six Sigma refers to a defect rate of 3.4 defects per million opportunities and represents a statistically high standard of quality"
        (3) Utilizes five steps to evaluate metrics, known as DMAIC, **D**efine, **M**easure, **A**nalyze, **I**mprove, and **C**ontrol
        (4) Focuses on the reduction of variation to improve processes
        (5) The goal is to permanently resolve errors by focusing on the underlying processes
    b. Lean Six Sigma
        (1) Has a strong focus on eliminating waste by removing non-value activities including defects, unnecessary or redundant steps, using value stream mapping (VSM)
        (2) It focuses on the process and works best if all employees are involved
        (3) According to Sitterding and Everett, Lean Six Sigma creates a "culture and practices that continually improve all functions by all people at all levels in the organization, and also utilizes the DMAIC model"
    c. Plan Do Study Act (PDSA)
        (1) Is a process for enacting and evaluating change
        (2) According to Nakayama et al. it has been recommended by the Joint Commission and the Institute of Medicine as an effective tool for complex processes
        (3) The four step scientific method to enact and evaluate change: **P**lanning, **D**o it—or implement the change, **S**tudy the results, and **A**ct—which may include modifying the change based on the results of the initial test
    d. Failure Mode and Effects Analysis (FEMA)
        (1) Can be used throughout the system life cycle to evaluate processes for real or potential failure points
        (2) The processes are mapped out and each step of the process is documented
        (3) Flow charts or Swim Lane Process maps can be used to help visualize the process maps
        (4) The process maps, or process flows are then used to identify where in the process there are risks for failure (or errors), and the associated risk—including the severity and likelihood
        (5) The FEMA team, which includes representatives of all affected areas, then identifies solutions and implements them
        (6) The implementation is followed by an evaluation, and reevaluation process until no failures can be identified
6. System design issues can create errors or minimize the risk of errors
7. By studying and documenting the workflow and processes problems with the current system (paper or electronic) the clinical system can be designed to
    a. Minimize the risk of errors
    b. And to decrease the risk of errors by both good design
    c. And by embedding EBP and CDS
    d. Using alerts as warnings and suggestions
8. One way to visualize the progress of quality improvement initiatives as well as organizational goals is with reports and dashboards

Teaching Tip
Refer to Table 13.10 is an example of an executive dashboard that enables leadership to "visualize strategic metrics to guide decision making grounded in actionable information."

9. A more detailed report that is printed, e-mailed, or viewed on-line each shift can give timely and meaningful feedback to the staff entering the information into the CIS so that any issues can be fixed in a timely manner, improving learning and compliance

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- This chapter reviews the stages of the system life cycle and some of the tools available that can be modified to assist with each phase in almost any scenario
- Tools like workflow analysis and documentation can be utilized in multiple phases, and may be displayed in many ways
- Like the nursing process of **A**ssessment, **D**iagnosis, **O**utcomes/**P**lanning, **I**mplementation, and **E**valuation (American Nurses Association, n.d.), the system life cycle is a continuous cycle that involves complex teams, and requires involving those affected—or the end users and other stakeholders
- Design is a continuous cycle based on user requirements and recommendations as well as regulatory changes and new research on best practices which need to be imbedded in the CIS
- Because of these changes as well as upgrades, testing, and evaluation will also be done throughout the system life cycle

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Identify two tools to assist with each phase of the System Life Cycle
- Describe two pre- and post-implementation metrics
- Describe diagrams that can be utilized for clinical workflow and data workflow
- Discuss ways to assess the reporting needs of an organization in relationship to all levels of staff

Teaching Tip

Ask the students to define the keywords

- Business intelligence
- Clinical workflow
- Data workflow
- Failure modes and effects analysis (FEMA)
- Lean methodology
- Lean
- Root cause analysis (RCA)
- Plan Do Study Act (PDSA)
- Process diagram
- Systems life cycle

CHAPTER REVIEW QUESTIONS

Question 13.1: Compare the Systems Life Cycle to what nursing model used in nursing plans of care.

a. Nursing Process continuous series of system changes
b. Nursing Plan of Care six phases of nursing care
c. Nursing Practice protocols
d. Evidence-Based nursing outcomes

Question 13.2: What best describes the data required for all phases of the SLC?

a. Determining the Data Elements selected for the Design Phase of the System
b. Analyzing the Data and the Workflow Data as a way to understand how a system works
c. Identifying the Data Elements used for the Documentation of System progress notes
d. Determining the Data Elements for the system plans of care protocols

Question 13.3: What best collect and depict the System Workflow Data?

a. Only by walking through the steps via intensive interviews
b. Only by observing the workflow process for any given activity
c. Only by Intensive Interview with those familiar with the process, by observation, and/or a combination of both
d. Only by reading about the workflow processes for any given activity

Question 13.4: What best describes Workflow Diagrams used to document the current state when planning a SLC?

a. Workflow Diagrams document the processes of the users. True ___ False ___
b. Data Workflow Diagrams document the interactions and the flow of the data in the information system. True ___ False ___
c. A Swim Lane Diagram is a type of Workflow Diagram used to document a process but not usually grouped in lanes. True ___ False ___
d. A Data Flow Diagram is another type of Workflow Diagram used to display the processes being implemented. True ___ False ___
e. A workflow Diagrams displays the process which needs to be clear and accurate. True ___ False ___

Question 13.5: Selecting an Information System needs to meet the needs of all levels of stockholders. What are the TIGER attributes for successful implementations?

a. Clinicians worked with developers and Users became involved only when problems arose in the implementation phase
b. User and Key Stakeholder became involved early in the project and Clinicians worked with developers to create definitions, wording, and graphics that represented workflow process
c. Key Stakeholders were not involved early in the project and Clinicians developed and designed the definitions and workflow without assistance from the developers
d. Clinicians were solicited to develop definitions and workflow whereas Users were not involved until the implementation phase

Question 13.6: What are the major characteristics of the System Life Cycle Tools?

a. Systems must be easy to use, must prompt clinicians with decision support analytics, must select hardware and software, and must provide business intelligence to capture financial and operational data
b. Systems must prompt clinicians with decision support analytics, must provide warnings, must provide business intelligence to capture financial and operational data, and must select hardware and software
c. Systems must be easy to use, must prompt clinicians with decision support analytics, must select hardware and software, and must provide warnings
d. Systems must be easy to use, must prompt clinicians with decision support analytics, must provide warnings, and must provide business intelligence to capture financial and operational data

Question 13.7: What are the key requirements for the System Implementation?

a. Requires System Optimization, System Outcomes, and System Design
b. Requires System Design, System Building, and System Testing
c. Requires System Testing, System Optimization, and System Building
d. Requires System Building, System Testing, and System Outcomes

Question 13.8: Identify how two System Optimization and Metrics are provided?

- **a.** Evaluate the system changes due upgrades, regulatory and payer changes, and clinical changes due to new research
- **b.** Evaluate the changes due to new staffing authority
- **c.** Evaluate the changes due to new system vendor changes
- **d.** Get pre- and post-metrics for charting accuracy and completeness

Question 13.9: Which are considered the best way to Measure Continuous Quality Improvement Processes?

- **a.** Six Sigma, Lean Six Sigma, PDSA, and FMEA
- **b.** PDSA, Six Sigma, FMEA, and Staffing Schedule
- **c.** FMEA, Staffing Schedule, Lean Six Sigma, and PDSA
- **d.** Six Sigma, PDSA, Lean Six Sigma, and Acuity Method

Question 13.10: Identify what CQI processes affect the Clinical Information System?

- **a.** Using Alerts can issue warnings and suggestions, using Dashboards can visualize strategic metrics, and develop strategies to guide evidence-based decision making, using a Nursing terminology for a PoC
- **b.** Documenting Workflow processes can minimize risk of errors, using Alerts can issue warnings and suggestions, using Dashboards can visualize strategic metrics, and develop strategies to guide evidence-based decision making
- **c.** Documenting Workflow processes can minimize risk of errors, using Dashboards can visualize strategic metrics, using s Nursing Terminology for a PoC, and develop strategies to guide evidence-based decision making
- **d.** Using a Nursing Terminology for a PoC, documenting Workflow processes can minimize risk of errors, using Alerts can issue warnings and suggestions, and using Dashboards can visualize strategic metrics

ANSWERS AND EXPLANATIONS

Question 13.1: (a) Nursing Process continuous series of system changes. It is compared to the SLC because it is a continuous series of system Changes, or evolutions. Even after the system is installed, there is continuous analysis, design, and implementation of new modules, upgrades and improvements.

Question 13.2: (b) Analyzing the Data and the Workflow Data as a way to understand how a system works. They are the best way to understand how a system works and how the different data elements in the system interact.

Question 13.3: (c) Only by Intensive Interview with those familiar with the process, by observation, and/or a combination of both. Interviewing staff about how an order is processed from the time it is entered until it is completed is an example using the interview to document a process. However, a combination of observation and interviews might be the most effective way to capture all of the nuances.

Question 13.4:

- **a.** True
- **b.** True
- **c.** False
- **d.** True
- **e.** True

Question 13.5: (b) User and Key Stakeholder became involved early in the project and Clinicians worked with developers to create definitions, wording, and graphics that represented workflow process. Selecting a system that meets the needs of all levels of stockholders from bedside staff to the executive team is a complicated process with multiple factors involved. The TIGER Usability and Clinical Application design team came up with the following attributes of successful implementation.

Question 13.6: (d) Systems must be easy to use, must prompt clinicians with decision support analytics, must provide warnings, and must provide business intelligence to capture financial and operational data. Understanding how the different part of the system work together as well as how the system will impact the clinical workflow is the key to be considered during the selection process. While having a system that is easy to learn and use is important, however, if the data cannot be reported or shared, its value decreases significantly.

Question 13.7: (b) Requires System Design, System Building, and System Testing. System design should involve key stakeholders, especially end users throughout. Testing involves making sure that each part of the system works and that the system works correctly with other modules and system.

Question 13.8: (a) Evaluate the system changes due upgrades, regulatory and payer changes, and clinical changes due to new research. The system changes are evaluated after the system is implemented, the process of system changes does not end. System optimization and support along with changes all lead to constant changes with the system.

Question 13.9: (a) Six Sigma, Lean Six Sigma, PDSA, and FMEA. This group of CQI begins with the culture of change and improvement, and encourages all levels of staff to look for ways to improve the current process. One way to visualize progress of CQI as well as organizational goals is with reports and dashboards.

Question 13.10: (b) Documenting Workflow processes can minimize risk of errors, using alerts can issue warnings and suggestions, use of Dashboards can visualize strategic metrics, and develop strategies to guide decision making. The items above are critical to visualize the progress of quality improvement of a Clinical Information System.

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14

Healthcare Project Management

• OBJECTIVES

1. Describe the five process groups in project management methodology, and identify key inputs and outputs for each.
2. Illustrate the "triple constraint" relationship between scope, cost, and time and how it can impact project quality.
3. Explain how a clinical system project is initiated and the role of the project charter.
4. Identify five techniques that will positively impact the quality, efficiency, and effectiveness of a clinical system implementation.

• KEY WORDS

Project management
Project methodology
Health information technology
Process groups
Triple constraint

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Should a project be managed? What are problems that could occur if a project is not managed? Why is project management important? Do you know a project manager? What skills should a project manager possess? Why is project management important in healthcare?

For a WIIFM statement, say to the class, "This chapter augments the System Life Cycle chapters, as it outlines the project management phases, called Process Groups, used to organize and structure the System Life Cycle in order to successfully complete all the implementation steps of a project. The Overview section will provide an introduction to project management and background information on project definitions and project manager skills. Each subsequent section will review one of the five project management process groups. The last section will describe some additional considerations for health information technology projects, such as governance and positioning of project management in the healthcare organization." As a nurse, it is important to understand project management.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Introduction

1. It's difficult to read a newspaper, magazine, or Web page today without somehow hearing about the impact of information technology
2. Information in all forms is traveling faster and being shared by more individuals than ever before
3. Think of how quickly you can buy just about anything online, make an airline reservation or book a hotel room anywhere in the world
4. Consider how fast you can share photos or video clips with your family and friends

5. This ubiquitous use of technology is permeating the healthcare industry as well
6. The future of many organizations may depend on their ability to harness the power of information technology
7. Particularly in the area of electronic health records and health information exchange
8. Good project management is needed in order to
    a. Accomplish the work
    b. Facilitate the change
    c. Deliver the improvements facilitated by the health information technology implementation
9. Project management is not a new concept
    a. It has been practiced for hundreds of years
    b. As any large undertaking requires a set of objectives, a plan, coordination, the management of resources, and the ability to manage change
10. Project management has become more formal with a specified body of knowledge
11. Many healthcare organizations have adopted the project-oriented approach as a technique to define and execute on their strategic goals and objectives
12. Good project managers for health information technology projects are in high demand
13. Colleges have responded by establishing courses in project management and making them part of the health informatics' curriculums for
    a. Continuing education
    b. Certificate
    c. Degree programs
14. This chapter provides a high-level look at the methodology behind project management in order to provide
    a. A framework for the project manager skills' development
    b. Structure for the implementation work processes
    c. Organization of the projects' tasks

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Chapter Overview

1. This chapter augments the System Life Cycle chapters
    a. It outlines the project management phases, called *Process Groups*
    b. Used to organize and structure the System Life Cycle
    c. In order to successfully complete all the implementation steps of a project
2. The Overview section will provide an introduction to project management and background information on project definitions and project manager skills
3. Each subsequent section will review one of the five project management process groups
4. The last section will describe some additional considerations for health information technology projects, such as
    a. Governance and positioning of project management in the healthcare organization

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

What is a Project?

1. There are many different definitions of what a project is
2. The definitions all have the same components
    a. A project is temporary
    b. Has a defined beginning and end
    c. And is managed to time, budget, and scope
3. Kerzner defines a project as
    a. A temporary endeavor
    b. Undertaken to create a unique product, service, or result
    c. Distinguishing features of a project are
        i. Specific objectives
        ii. Defined start and end dates
        iii. Defined funding limitations
        iv. Consumption of resources (human, equipment, materials)
        v. And is often multifunctional or cross-organizational by design
4. The Project Management Institute (PMI) defines a project as
    a. "A temporary endeavor undertaken to create a unique product or service with a definite beginning and a definite end"
    b. "The product or service is different or unique from other products or services"
5. Schwalbe differentiates a project from operations
    a. By defining operations as ongoing work done to sustain the business
    b. Projects are different from operations in that they end when the project objectives are reached or the project is terminated

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

What is Project Management?

1. Project management is facilitation of the
    a. Planning
    b. Scheduling
    c. Monitoring
    d. Controlling of all work that must be done to meet the project objectives
2. PMI states that "project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements"

3. It is a systematic process for implementing systems on time, within budget, and in line with customer expectations of quality
4. Project managers must strive to meet
    a. Specific scope
    b. Time
    c. Cost
    d. Quality project goals
5. Project managers must also
    a. Facilitate the entire process to meet the needs
    b. And expectations of the people involved in or affected by project activities

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Introduction to the five Process Groups

1. The project management process groups progress
    a. From initiation activities
    b. Two planning activities
    c. Executing activities
    d. Monitoring and controlling activities
    e. And closing activities
2. Each of these will be described in detail in the ensuing sections of this chapter
3. It is important to note here that
    a. These groups are integrated and not linear in nature
    b. So that decisions and actions taken in one group can affect another

Teaching Tip
Refer to the chapter Figure that shows the five groups and how they relate to each other in terms of typical level of activity, time, and overlap. Of course, the level of activity and length of each process group varies for each project.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Project Management Knowledge Areas

Teaching Tip
Provide the following content, the Project Management Knowledge Areas describes the key competencies that project managers must develop and use during each of the Process Groups. Each of these competencies has specific tools and techniques associated with it, some of which will be elaborated in the following sections of this chapter.

Teaching Tip
Refer to chapter table that shows the nine knowledge areas of project management. The four core areas of project management (bolded in the table) are project scope, time, cost, and quality management. These are considered core as they lead to specific project objectives. The four facilitating knowledge areas of project management are human resources, communication, risk, and procurement management. These are considered facilitating as they are the processes through which the project objectives are achieved. The ninth knowledge area, project integration management, is an overarching function that affects and is affected by all of the other knowledge areas. Project managers must have knowledge and skills in all of these nine areas.

1. Initiating Process Group
    a. The Initiating Process Group (IPG) is defined by the PMI as follows, "those processes performed to authorize and define the scope of a new phase or project or that can result in the continuation of halted project work"
    b. The purpose of the IPG is to formally define a project, including
        (1) The business need
        (2) Key stakeholders
        (3) The project goals
    c. A clear definition of the business case is critical for
        (1) Defining the scope of the project
        (2) And for identifying the opportunity associated with completing the project
    d. The business case includes the potential risks associated with completing or not completing the project at a given point in time
    e. The work completed throughout the IPG
        (1) Builds a foundation for buy-in and commitment from the project sponsors
        (2) And establishes an understanding of the associated challenges
    f. The IPG is characterized by information gathering and research that leads to full disclosure of both the benefits and the costs associated with a given project
    g. Historical information is assembled during the IPG to identify related projects or earlier attempts at similar projects
    h. Historical information provides insight into challenges associated with the project and buy-in from stakeholders
    i. The IPG
        (1) May lead to formal project selection
        (2) Or it may culminate in a decision to forgo or to postpone a project
    j. The set of work completed in the IPG is often done directly
        (1) For a business sponsor
        (2) And may be accomplished without a formal project team in place

k. During the IPG the goals of the proposed project are analyzed
  (1) To determine the project scope
  (2) And associated time, costs, and resource requirements

l. Key stakeholders are identified and may be engaged in
  (1) Defining the project scope
  (2) Articulating the business case
  (3) Developing a shared vision for the project deliverables

m. The inputs needed to support the work of the IPG include tools and information that support the knowledge area of project integration management

n. "Project integration management includes the processes and activities needed to identify, define, combine, unify, and coordinate the various processes and project management activities within the project management process groups"

o. Sound integration management contributes to a solid understanding of whether the project is a good match for the organization and if so, how the project fits into the organizational mission and vision.

p. The involvement of stakeholders in the process of project integration management is
  (1) Fundamental to their engagement in the project
  (2) And involvement in defining and working toward project success

q. Informational inputs such as
  (1) The sponsor's description of the project
  (2) The organizational strategic plan
  (3) The published organizational mission
  (4) And historical information on related projects support the integration work of the IPG

r. Examples of tools and techniques that facilitate completing the information gathering, research, and related analysis required during the IPG include the
  (1) SWOT (e.g., Strengths, Weaknesses, Opportunities, Threats) analysis
  (2) Stakeholder analysis
  (3) And the value risk assessment

Teaching Tip
Refer to the relevant Table and Figure.

s. Tangible outputs of the IPG include
  (1) The completed project charter that formally defines the project, including the business case, key stakeholders, project constraints, and assumptions
  (2) The project charter includes the signatures of the project sponsors and team members, indicating a shared vision for the project and formal approval to move forward with planning the project
  (3) The outputs from the IPG are used to inform project planning and reused during project closure to facilitate evaluation of the project deliverables

2. Planning Process Group

a. The Planning Process Group (PPG) is often the most difficult and unappreciated process in project management

b. The PPG is one of the most important and should not be rushed

c. This is the phase where decisions are made
  (1) On how to complete the project
  (2) And accomplish the goals and objectives defined in the Initiating Process Group

d. The *project plan* is created, whose main purpose is to guide the project execution phase
  (1) The plan must be realistic and specific
  (2) So a fair amount of time and effort needs to be spent and people knowledgeable about the work need to help plan the work
  (3) The project plan also provides structure for the project monitoring and controlling process
  (4) As it creates the baseline to which the work is measured against as it is completed

e. During the initiating phase
  (1) A lot of information was collected to define the project
  (2) Including the scope document and project charter
  (3) Which provide validation and approval for the project

f. During the planning phase
  (1) The approach to accomplish the project is defined to an appropriate level of detail
  (2) This includes defining the necessary tasks and activities in order to estimate the resources, schedule, and budget
  (3) Failure to adequately plan greatly reduces the project's chances of successfully accomplishing its goals

g. Project planning generally consists of the following steps
  (1) Define project scope
  (2) Refine project objectives
  (3) Define all required deliverables
  (4) Create a framework for the project schedule
  (5) Select the project team
  (6) Creating the work breakdown structure
  (7) Identify the activities needed to complete the deliverables
  (8) Sequence the activities and define the critical path activities
  (9) Estimating the resource requirements for the activities
  (10) Identify required skills and resources
  (11) Estimating work effort; time and cost for activities
  (12) Developing the schedule
  (13) Developing the budget
  (14) Complete risk analysis and avoidance
  (15) Create a communication plan
  (16) Gaining formal approval to begin work

Teaching Tip
Provide the information that some of the tools and techniques employed during the PPG are listed in the relevant Table.

- **h.** One of the most important is the Work Breakdown Structure (WBS)
- **i.** Projects are organized and understood
  - **(1)** By breaking them into a hierarchy, with progressively smaller pieces
  - **(2)** Until they are a collection of defined "work packages" that include tasks
  - **(3)** The WBS is used as the outline to provide a framework for organizing and managing the work
  - **(4)** The deliverable of this phase is a comprehensive project plan that is approved by the sponsor(s) and shared with the project team in a project kick-off meeting

3. Executing Process Group

- **a.** The Executing Process Group (EPG) is defined by the PMI as follows, "Those processes performed to complete the work defined in the project management plan to accomplish the project's objectives defined in the project scope statement"
- **b.** The EPG is characterized by
  - **(1)** Carrying out the work of the project
  - **(2)** And associated activities defined by the project plan to meet project requirements
- **c.** During the EPG the project team follows the project plan
- **d.** Each team member contributes to the ongoing progress of the plan
- **e.** Project deliverables are managed during the EPG by
  - **(1)** Careful tracking of scope
  - **(2)** Time and resource use with ongoing updates made to the project plan and timeline to reflect progress made
- **f.** The key responsibilities of the project manager during the EPG are integration of the project team and activities to keep the work of the project moving toward the established milestones set during the project planning phase (e.g., PPG)
- **g.** Clear communication and effective management of project resources are essential
- **h.** The inputs needed to support the work of the EPG include tools and information that facilitate assimilation of the following knowledge areas into project efforts
  - **(1)** Integration management
    - **i.** Coordination of project resources and activities to complete the project on time, within budget
    - **ii.** In accordance with the project scope defined by the customer
  - **(2)** Quality management
    - **i.** Monitoring of project performance to ensure that the deliverables will satisfy the quality requirements specified by the customer
  - **(3)** Human resource management
    - **i.** Enhancing and motivating performance of project team members
    - **ii.** To ensure effective use of human resources to advance project deliverable
  - **(4)** Communication management
    - **i.** Distribution of information in a complete and timely fashion
    - **ii.** To ensure all stakeholders are informed and miscommunication channels are minimized
  - **(5)** Procurement management
    - **i.** Obtaining goods and services from outside an organization
    - **ii.** Including identifying and selecting vendors and managing contracts
- **i.** The inputs needed to support the work of the EPG
- **j.** Includes tools and information that promote clear communication, control the work, and manage project resources

Teaching Tip
Provide the information that some common tools employed during the EPG are described in the relevant Table.

- **k.** The tools and techniques used during the EPG and associated documentation
  - **(1)** Facilitate completion of project work and provide a means to identify
  - **(2)** And track ongoing activities against the project plan
- **l.** Variances may arise during project execution
  - **(1)** And may trigger an evaluation
  - **(2)** And a re-planning of activities
- **m.** Deliverables produced through the use of the EPG input tools and techniques
  - **(1)** Are then used as outputs
  - **(2)** To inform the work conducted over subsequent process group phases

Teaching Tip
Provide the following example, during the EPG, the Gantt chart provides a means to monitor whether the project is on schedule and for managing dependencies between tasks. This same tool is useful in the monitoring and controlling process groups (MCPG) where the Gantt chart is used to proactively identify when remedial action is needed and to ensure that project milestones are met in accordance with the project plan.

4. Monitoring and Controlling Process Group

- **a.** The purpose of the Monitoring and Controlling Process Group (MPG)
  - **(1)** Is to observe project execution
  - **(2)** So that the issues and potential problems can be identified in a timely manner
  - **(3)** And corrective action can be taken when necessary to control execution of the project
- **b.** It is the process of
  - **(1)** Measuring progress toward project objectives
  - **(2)** Monitoring deviation from the plan
  - **(3)** And taking corrective action to ensure progress matches the plan

- **c.** The MPG is
    - **(1)** Performed throughout life of project across all phases
    - **(2)** And provides feedback between project phases
- **d.** The project manager facilitates project control by
    - **(1)** Measuring actual performance against the planned or estimated performance
    - **(2)** From the project plan in the areas of scope, resources, budget, and time
- **e.** The key benefits of project control are that when project performance is observed and measured regularly
    - **(1)** Variance to the plan can be identified
    - **(2)** And mitigated quickly to minimize delays and avoid cost overruns
- **f.** Estimates say that
    - **(1)** 80 percent of healthcare projects fail
    - **(2)** One-third are never completed
    - **(3)** And most are over budget, behind schedule
    - **(4)** Or go live with a reduced scope
- **g.** The reasons for these failures vary
    - **(1)** Project control can help improve on-time, on-budget, and in-scope delivery of projects
- **h.** During the control phase, the project manager needs to support the project team
    - **(1)** With frequent checks
    - **(2)** And recognition of the completion of incremental work efforts
- **i.** This way, the project manager can adapt the work as needed
- **j.** Project managers also need to work with the project sponsors to identify the risks of
    - **(1)** Keeping on time and on budget
    - **(2)** Versus modifying the schedule or scope to better meet the organizations' need for the project

5. The triple constraint

- **a.** Every project is constrained in some way by
    - **(1)** Scope
    - **(2)** Cost
    - **(3)** Time
- **b.** These limitations are known as the triple constraint
- **c.** They are often competing constraints that need to be balanced by the project manager throughout the project life cycle
- **d.** Scope refers to the work that needs to be done to accomplish the project goals
- **e.** Cost is the resources required to complete the project
- **f.** Time is the duration of the project
- **g.** The concept is that a modification to the project will impact
    - **(1)** One or more of the three constraints
    - **(2)** Often require trade-offs between them

Teaching Tip

Provide the example, if there is an increase in scope, either cost or time or both will need to be increased as well. Or in another example, if time is decreased when a deadline is moved up, either scope will need to decrease or cost (resources) will need to increase. It is a balancing act.

Teaching Tip

Provide the information that the tools and techniques employed during the MPG are described in the relevant Table.

6. Closing Process Group

- **a.** The Closing Process Group (CPG) is defined by the PMI as follows, "Those processes performed to formally terminate all activities of a project or phase and transfer the completed product to others or close a cancelled project"
- **b.** The goal CPG is
    - **(1)** To finalize all project activities
    - **(2)** And to formally close the project
- **c.** During the CPG the project goals and objectives set during the IPG are
    - **(1)** Compared with deliverables
    - **(2)** And analyzed to determine the project success
- **d.** Key stakeholders are engaged with evaluating the degree to which project deliverables were met
- **e.** The inputs needed to support the work of the CPG include the outputs from earlier process group phases and the tools and information that support the knowledge areas of project integration and procurement management
    - **(1)** Integration management
        - **i.** Coordination of project closure activities
        - **ii.** Including formal documentation of project deliverables
        - **iii.** And formal transfer of ongoing activities from the project team to established operational resources
    - **(2)** Procurement management
        - **i.** Coordination of formal contract closure procedures
        - **ii.** Including resolution of open issues and documentation of archival of information to inform future projects

Teaching Tip

Provide the information that some common tools employed during the CPG are described in the relevant Table.

- **f.** The tools and techniques used during the CPG and associated documentation
    - **(1)** Facilitate project closure
    - **(2)** And provide a means to identify lessons learned
- **g.** These tools and techniques are used to
    - **(1)** Document best practices
    - **(2)** Including updates to the organization's project management toolbox

  - **h.** During the CPG, standard tools available to the project team to support best practices
    - **(1)** Are identified
    - **(2)** And made available to support application of best practices in future projects
  - **i.** Including a formal step for adapting the project management toolbox during the CPG
    - **(1)** Ensures that the toolbox remains pertinent
    - **(2)** And continues to support best practices relative to the types of projects typically conducted within an organization

Other Considerations

1. Project governance
   - **a.** There is just no question that successful projects are owned and sponsored by the leaders and staff that
     - **(1)** Will be making the practice change
     - **(2)** Will be benefiting by the change
   - **b.** In the ideal scenario, the Governance Committee(s)
     - **(1)** Are led by top business and clinical leaders
     - **(2)** With membership built on broad representation from key business and clinical departments
   - **c.** In addition to evaluating and ranking the technology project proposals brought to them
     - **(1)** They take responsibility for generating an overall roadmap to use to compare against each proposal
   - **d.** They set guiding principles for concepts like integration versus best-of-breed systems
   - **e.** They consider where the organization needs to be going and what practice and care changes are required
   - **f.** They then solicit proposals from the strategic business units who are responsible for making those changes
   - **g.** In other words, they don't just see themselves as "governing" the project selection process
     - **(1)** But rather as "driving" the implementation of projects that support strategic initiatives and deliver strategic value
   - **h.** It may be a nuance here
     - **(1)** There is a real argument that these are not Governance Committees that pick IT projects
     - **(2)** But are Governance Committees that allocate IT resources to strategic projects
2. Skills needed for project managers
   - **a.** There is general agreement that good project managers need to have both people skills and leadership skills
   - **b.** Here is one skills list that describes the many facets of the project manager role
     - **(1)** Communication skills: Listens, persuades
     - **(2)** Organizational skills: Plans, sets goals, analyzes
     - **(3)** Team-building skills: Shows empathy, motivates, promotes esprit de corps
     - **(4)** Leadership skills: Sets examples, provides vision (big picture), delegates, positive, energetic
     - **(5)** Coping skills: Flexible, creative, patient, persistent
     - **(6)** Technology skills: Experience, project knowledge
3. Project management office (PMO)
   - **a.** There are different ways to position project managers in a healthcare organization
     - **(1)** Some have them in the information technology department
     - **(2)** Some have them in the clinical department
     - **(3)** Others have them in an informatics department
     - **(4)** And still others have matrix roles
   - **b.** Many have now created a project management office to provide best practices and support for managing all projects in an organization
   - **c.** The office can also provide
     - **(1)** Education
     - **(2)** Coaching and mentoring
     - **(3)** As well as project management resources
   - **d.** With the federal incentives for health information technology
     - **(1)** The industry has begun the challenging task of implementing electronic health record system projects
     - **(2)** To demonstrate meaningful use
   - **e.** With this increase in projects
     - **(1)** There is an increased demand for good project managers
     - **(2)** And the consistent project management methodology for completing projects
4. Project Management Institute
   - **a.** The Project Management Institute (PMI) was founded in 1969 by a group of project managers
   - **b.** It is considered to be the leading professional organization for project managers worldwide
   - **c.** The primary goal of the PMI is "to advance the practice, science and profession of project management throughout the world in a conscientious and proactive manner so that organizations everywhere will embrace, value, and utilize project management and then attribute their successes to it"
   - **d.** The PMI publishes the *Guide to the Project Management Body of Knowledge (PMBOK® Guide)* which is a collection of consensus-based standards and best practices
   - **e.** The *PMBOK® Guide* is currently in its 5th edition and has been adopted as an American National Standard (ANSI)
5. Project Management Professionals
   - **a.** The Project Management Institute (PMI) offers multiple levels of credentialing to assist project professionals with advancing their careers in
     - **(1)** Project
     - **(2)** Program
     - **(3)** Portfolio management
   - **b.** PMI credentials are available related to many aspects of project management, including
     - **(1)** Program management
     - **(2)** Scheduling
     - **(3)** Risk management

   c. PMI membership is not required for credentialing
   d. PMI credentialing requires that candidates successfully pass a credentialing exam in addition to meeting a set of published prerequisite requirements
   e. Complete information about PMI credentials and the credentialing process can be accessed from the PMI Web site
6. Project management resources on the web
   a. Many Web-based resources exist to support project management best practices
   b. A recent search using the key words "project management resources" on a popular search engine returned over 70 million results
   c. A list of validated Web-based resources is included in the Resource List at the chapter end

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- Today, as so often in history, healthcare resources are limited
- Yet there are many, varied, and complex healthcare technology projects demanding resources
- So how does one ensure that healthcare dollars and clinician time are spent wisely on projects that guarantee patient-driven outcomes
- In addition to selecting and funding the projects wisely, the authors believe, good project management also minimizes risk and enhances success
- We further contend that clinicians, and particularly nurses, are excellent candidates, once trained in PM techniques, to be good project managers
- Executive management should support, and maybe even demand, project management training for the organization's clinical IT project team leaders
- Nursing informatics has been evolving since its inception some 25 years ago
- More often than ever, project management skills are being included in training and formal education programs
- And, increasingly, informatics nurses are stepping up to the plate and taking on key roles in the planning, selection, implementation, and evaluation of the critical clinical systems needed in healthcare today
- We hope that we have provided a glimpse as to the skills that will enable this to happen
- Good project management holds part of the key to consistent success with electronic health record system implementations in healthcare today

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe the five process groups in project management methodology, and identify key inputs and outputs for each
- Illustrate the "triple constraint" relationship between scope, cost, and time and how it can impact project quality
- Explain how a clinical system project is initiated and the role of the project charter
- Identify five techniques that will positively impact the quality, efficiency, and effectiveness of a clinical system implementation

Teaching Tip
Review the keywords. Ask the students to define the keywords.

- Project management
- Project methodology
- Health information technology
- Process groups
- Triple constraint

CHAPTER REVIEW QUESTIONS

Question 14.1: What best describes "Project Management"?

a. It is used to measure objectives and outcomes
b. It facilitates planning, scheduling, monitoring, and controlling of all work
c. It represents the application of knowledge
d. It is a systematic process of evaluations

Questions 14.2: What best describes "Project Management" as stated by the Project Management Institute (PMI.)?

a. It is the application of knowledge, skills, tools and techniques to project activities to meet project requirements
b. It is an endeavor that focuses on privacy and security
c. It describes hardware evaluation and selection
d. It represents the needs of the people involved

Question 14.3: What are considered to be the four core areas of Project Management?

a. Time, Project Scope, Cost and Risk
b. Risk, Quality Management, Time, and Cost
c. Cost, Project Scope, Risk, and Time
d. Project Scope, Time, Cost, and Quality Management

Question 14.4: What are considered to be the four facilitating Knowledge Areas of Project Management?

a. Communication, Risk, Procurement Management, and Time Management
b. Procurement Management, Time Management, Communication, and Risk

c. Human Resources, Communication, Risk, and Procurement Management

d. Risk, Human Resources, Time Management, and Communication

Question 14.5: What are the five Project Management Process Groups that are integrated and related to each other in terms of typical level of activity, time, and overlap?

a. Initiating, Planning, Executing, Monitoring and Controlling, and Closing

b. Closing, Monitoring and Controlling, Initiating, Managing, and Planning

c. Executing, Planning, Initiating, Closing, and Managing

d. Monitoring and Controlling, Planning, Managing, Initiating, and Closing

Question 14.6: The Process Groups describe the key competencies of project managers. Indicate if statement is True or False?

a. Initiating Process Group: Purpose is to implement the project. True ___ False ___

b. Planning Process Group: Purpose is to guide the project execution phase. True ___ False ___

c. Executing Process Group: Purpose is to carry out the defined work. True ___ False ___

d. Monitoring and Controlling Process Group: Purpose is to measure progress. True ___ False ___

e. Closing Process Group: Purpose is to keep all activities open. True ___ False ___

Question 14.7: What are some examples of Tools and Techniques that facilitate completing the information gathering, research related analysis, required during the IPG?

a. SWOT (Strengths, Weaknesses, Opportunities, Threats) Analysis, Stakeholder Analysis, and Value Risk Assessment

b. Completed Project Charter, Key Stakeholders, Project Constraint, and Project Assumptions

c. The Project Charter with signatures of project Sponsors, team members, indicate a Shared Vision for the Project and Formal Approval to move forward

d. Informational Inputs such as the sponsor's description of the Project, Organizational Strategic Plan, the Published Organizational Mission, and Historical Information on related Projects

Question 14.8: Which of the following Tools employed during the PPG is considered to be one of the most important?

a. RACI (Responsible, Accountable, Consulted, Informed) Chart that helps define Roles and responsibilities of project team

b. Risk Register with proprieties that the list of project risks

c. Work Breakdown Structure (WBS) which breaks them into hierarchy with progressive smaller pieces until they are a collection of defined work packages

d. Project Charter described the high-level scope, time, and cost goals of the project

Question 14.9: The Closing Process Group includes those processes to formally terminate all activities of a project. What are the Tools and Techniques used during the CPG?

a. Post-implementation Survey, Post-Mortem Review Document, Project Closeout Check list, and Gantt Chart

b. Post-implementation Survey, Post-Mortem review Document, Project Closeout Check list, and Outputs from earlier process groups

c. Post-Mortem review Document, Project Closeout Check list, and Outputs from earlier process groups, and Gantt Chart

d. Post-implementation Survey, Gantt Chart, Project Closeout Check list, and Outputs from earlier process groups

Question 14.10: What other Project Management activity should be addressed?

a. A Governance Committee that is identified as driving the implementation of the projects that support initiatives and deliver strategic value

b. A Project Manager that has software programming skills

c. Project Management Professionals education levels

d. Project Management resources on the Web that supports best practices

Answers and Explanations

Question 14.1: (b) It facilitates planning, scheduling, monitoring, and controlling of all work. This definition is different from the one by PMI below.

Questions 14.2: (a) It is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. It is a systematic process for implementing systems on time, within budget, and in line with customer expectations of quality.

Question 14.3: (d) Project Scope, Time, Cost, and Quality Management. These are considered core as they lead to specific project objectives.

Question 14.4: (c) Human Resources, Communication, Risk, and Procurement Management. These are considered facilitating as they are the processes through which the project objectives are achieved.

Question 14.5 (a) Initiating, Planning, Executing, Monitoring and Controlling, and Closing. The work completed by the five Project Management Process Groups augments the System Life Cycle chapters. They are used to organize and structure the Systems Life Cycle in order to successfully complete all the implementation steps of a project.

Question 14.6:

a. False

b. True

c. True

d. True

e. False

Each of these five Process Groups is described in detail in this chapter.

Question 14.7: (a) SWOT (Strengths, Weaknesses, Opportunities, Treats) Analysis, Stakeholder Analysis, and Value Risk Assessment. The IPG uses the Tools and Techniques for informational inputs for it. Whereas the tangible outputs include the completed project charter that formally defines the project including the business case, key stakeholders, project constraints, and assumptions.

Question 14.8: (c)Work Breakdown Structure (WBS) that breaks them into hierarchy with progressive smaller pieces until they are a collection of defined "work packages." This WBS is used as the outline to provide a framework for organizing and managing the work.

Question 14.9: (b) Post-implementation Survey, Post-Mortem review Document, Project Closeout Check list, and Outputs from earlier process groups. The Tools and Techniques used during CPG and associated documentation facilitate project closure and provide a means to identify lessons learned.

Question 14.10: (a) A Governance Committee that is identified as "driving" the implementation of the projects that support initiatives and deliver strategic value. It may be a nuance here, but there is a real argument that these are not Governance Committees that pick IT projects, but rather are Governance Committees that allocate IT resources to strategic projects.

PART 3

Informatics Theory Standards—Foundations of Nursing Informatics

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15

The Practice Specialty of Nursing Informatics

• OBJECTIVES

1. Relate the definition of nursing informatics and its qualifications as a distinct specialty.
2. Discuss models and theories that support nursing informatics.
3. Identify available organizational resources.
4. Describe the relationship of the standards of practice in nursing informatics to the scope of practice statement.

• KEY WORDS

Informatics
Competencies
Models
Theory
Nursing process
Scope of practice
Standards of practice
Standards of professional performance

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

> **Instructor Tip**
> **When gaining attention and establishing common ground, ask questions of the class, such as the following:** Can you give examples of a theory? Why is theory important? Why are professional organizations important to a profession? Do you belong to a professional organization? What value does it bring to you? Can you explain the scope and practice for nursing? Why is it important to have standards and a scope of practice for nursing and nursing informatics?

For a WIIFM statement, say to the class, "This chapter addresses pertinent concepts, definitions, and interrelationships of nursing, nursing informatics, and healthcare nursing informatics. Evolution of definitions for nursing informatics is presented. The recognition of nursing informatics as a distinct nursing specialty is discussed. Models and theories of nursing informatics and supporting sciences are described. The identification of various sets of nursing-informatics competencies is explained. A collection of international and national organizations of interest to informatics nurses is presented. This chapter also addresses the requisite components of the scope of practice and the standards of practice and professional performance for nursing informatics." As a nurse, it is important to understand relevant theories as well as the scope and standards for nursing informatics.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to visit Internet websites relevant to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

OVERVIEW

Introduction

1. Decision making is an integral part of daily life
2. Nurses regularly make frequent, critical, life-impacting decisions

3. Good decisions require accurate and accessible data as well as skill in processing information
4. At the heart of nursing informatics is the goal of providing nurses with the data, information, and support for information processing to make effective decisions
5. This decision making can encompass any and all of the following areas of nursing practice
    a. Client care
    b. Research
    c. Education
    d. Administration

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics Nurse/Informatics Nurse Specialist

1. An informatics nurse (IN) is a registered nurse who has experience in nursing informatics
2. Informatics nurse specialists (INS) are prepared at the graduate level (master's degree) with specialty courses in nursing informatics
3. An INS functions as a graduate-level-prepared specialty nurse

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Foundational Documents Guide Nursing Informatics Practice

1. Nursing informatics practice and the development of this specialty has been guided by several foundational documents

Teaching Tip
Refer to the documents listed in Table 15.1.

2. In 2001, the American Nurses Association (ANA) published the *Code of Ethics for Nurses with Interpretive Statements*
    a. A complete revision of previous ethics provisions and interpretive statements that guide all nurses in practice
    b. Be it in the domains of direct patient care, education, administration, or research
3. Nurses working in the informatics specialty are professionally bound to follow these provisions
4. Terms such as
    a. Decision making
    b. Comprehension
    c. Information
    d. Knowledge
    e. Shared goals
    f. Outcomes
    g. Privacy
    h. Confidentiality
    i. Disclosure
    j. Policies
    k. Protocols
    l. Evaluation
    m. Judgment
    n. Standards
    o. Factual documentation abound throughout the explanatory language of the interpretive statements
5. In 2003, a second foundational professional document, *Nursing's Social Policy Statement, Second Edition*
    a. Provided a new definition of nursing that was reaffirmed in the 2010 *Nursing's Social Policy Statement: The Essence of the Profession*
    b. Nursing is the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities, and populations

Teaching Tip
Provide this information, informatics nurses must be cognizant of the statements and direction provided by this document to the nursing profession, its practitioners, and the public.

6. The ANA's *Nursing: Scope and Standards of Practice, Second Edition,* further reinforces the recognition of nursing as a cognitive profession
7. The exemplary competencies accompanying each of the 16 Standards of Professional Nursing Practice, comprised of Standards of Practice and Standards of Professional Performance, reflect the
    a. Specific knowledge
    b. Skills
    c. Abilities
    d. Judgment capabilities expected of registered nurses
8. The standards include
    a. Data
    b. Information
    c. Knowledge management activities as core work for all nurses
9. This cognitive work begins with the critical-thinking and decision-making components of the nursing process that occur before nursing action can begin
10. The nursing process provides a delineated pathway and process for decision making
    a. Assessment, or data collection and information processing, begins the nursing process
    b. Diagnosis or problem definition, the second step, reflects the interpretation of the data and information gathered during the assessment

   - **c.** Outcomes identification is the third step, followed by planning as the fourth step
   - **d.** Implementation of a plan is the fifth step
   - **e.** The final component of the nursing process is evaluation
   - **f.** The nursing process is most often presented as a linear process with evaluation listed as the last step
   - **g.** The nursing process really is iterative, includes numerous feedback loops, and incorporates evaluation activities throughout the sequencing

Teaching Tip
Provide this example, evaluation of a plan's implementation may prompt further assessment, a new diagnosis or problem definition, and decision making about new outcomes and related plans.

11. The collection of data about a client or about a management, education, or research situation is guided by a nurse's knowledge base built on
   - **a.** Formal and informal educational preparation
   - **b.** Evidence and research
   - **c.** Previous experiences

12. In healthcare, data, information, and knowledge are growing at astronomical rates and demand increasing reliance on computer and information systems for
   - **a.** Collection
   - **b.** Storage
   - **c.** Organization and management
   - **d.** Analysis
   - **e.** Dissemination

Teaching Tip
Provide this example, in clinical nursing practice, consider the significant expansion in the amount and types of data that *must* be collected for legal, regulatory, quality, and other reasons; the data, information, and knowledge, like genetic profiles, related to specific client health conditions; and the information and knowledge about the healthcare environment, such as that associated with billing and reimbursement, health plan, and available formulary options. Collecting data in a systematic, thoughtful way, organizing data for efficient and accurate transformation into information, and documenting thinking and actions are critical to successful nursing practice.

13. Nursing informatics is the nursing specialty that endeavors to make the
   - **a.** Collection
   - **b.** Management
   - **c.** Dissemination of data, information, and knowledge—to support decision making—easier for the practitioner, regardless of the domain and setting

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics and Healthcare Informatics

1. Informatics is a science that combines
   - **a.** A domain science
   - **b.** Computer science
   - **c.** Information science
   - **d.** Cognitive science

2. It is a multidisciplinary science, drawing from varied theories and knowledge applications

3. Healthcare informatics may be defined as the integration of
   - **a.** Healthcare sciences
   - **b.** Computer science
   - **c.** Information science
   - **d.** Cognitive science to assist in the management of healthcare information

4. Healthcare informatics is a subset of informatics

Teaching Tip
Provide the following example, imagine a large umbrella named informatics and imagine many persons under this umbrella. Each person represents a different domain science, one of which is healthcare informatics.

5. Because healthcare informatics is a relatively young addition to the informatics umbrella, you may see other terms that seem to be synonyms for this same area, such as
   - **a.** Health informatics
   - **b.** Or medical informatics

6. Medical informatics, historically, was used in Europe and the United States as the preferred term for healthcare informatics

7. Now, medical informatics is more clearly realized as a subset of healthcare informatics

8. Health informatics may mean informatics used in educating healthcare clients and/or the general public

9. As healthcare informatics evolves, so will the clarity in definition of terms and scopes of practice

10. Healthcare informatics addresses the study and management of healthcare information

11. A model of overlapping discrete circles could depict the integrated content most often considered representative of the multiple and diverse aspects of healthcare informatics

12. Healthcare informatics would be the largest encompassing circle surrounding smaller intersecting circles

13. These aspects include specific content areas such as
   - **a.** Information retrieval
   - **b.** Ethics
   - **c.** Security
   - **d.** Decision support
   - **e.** Patient care
   - **f.** System life cycle
   - **g.** Evaluation
   - **h.** Human-computer interaction (HCI)
   - **i.** Standards

   - **j.** Telehealth
   - **k.** Healthcare information systems
   - **l.** Imaging
   - **m.** Knowledge representation
   - **n.** Electronic health records (EHRs)
   - **o.** Education
   - **p.** Information retrieval

Teaching Tip
Ask the students to write down their preference of terms, medical informatics or health informatics. Ask the students to discuss and provide rationale for their preference.

Teaching Tip
Ask to design a model healthcare informatics and the specific content area using another shape than a circle as described by the chapter authors. Ask the students to provide rationale for their choice.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Nursing Informatics

1. Nursing informatics (NI) is a subset of healthcare informatics
2. It shares common areas of science with other health professions
3. Easily supports
   - **a.** Interprofessional
   - **b.** Education
   - **c.** Practice
   - **d.** Research focused on healthcare informatics
4. Nursing informatics also has unique areas that address the special information needs for the nursing profession
5. Nurses work both
   - **a.** Collaboratively with other healthcare professionals
   - **b.** Independently when engaged in clinical and administrative nursing practice
6. Nursing informatics reflects this duality as well, moving in and out of integration and separation as situations and needs demand
7. In 1985, Kathryn Hannah proposed a definition that nursing informatics is the use of information technologies in relation to any nursing functions and actions of nurses (Hannah, 1985)
8. Graves and Corcoran (1989) presented a more complex definition of nursing informatics. Nursing informatics is a combination of computer science, information science, and nursing science designed to assist in the management and processing of nursing data, information, and knowledge to support the practice of nursing and the delivery of nursing care
9. The ANA modified the Graves and Corcoran (1989) definition with the development of the first scope of practice statement for nursing informatics
   - **a.** The ANA (1994) defined nursing informatics as the specialty that integrates nursing science, computer science, and information science in identifying, collecting, processing, and managing data and information to support nursing practice, administration, education, research, and the expansion of nursing knowledge
10. The explanation of the accompanying standards of practice for nursing informatics followed in 1995 with ANA's publication of the *Standards of Nursing Informatics Practice*
11. In 2000, the ANA convened an expert panel to review and revise the scope and standards of nursing informatics practice
    - **a.** That group's work included an extensive examination of the evolving healthcare and nursing environments and culminated in the publication of the *Scope and Standards of Nursing Informatics Practice* (2001b)
12. This professional document includes an expanded definition of nursing informatics that was slightly revised in the 2008 *Nursing Informatics: Scope and Standards of Practice* to include wisdom
    - **a.** Nursing informatics (NI) is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice. NI supports consumers, patients, nurses, and other providers in their decision making in all roles and settings
    - **b.** Further into the revised document, a slightly amended definition is provided: Nursing informatics (NI) is a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice. NI facilitates the integration of data, information, knowledge, and wisdom to support patients, nurses, and other providers in their decision making in all roles and settings. This support is accomplished through the use of information structures, information processes, and information technology
13. The Nursing Informatics Special Interest Group of the International Medical Informatics Association (IMIA-NI) adopted the following definition in 2009
    - **a.** Nursing informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families, and communities world wide
    - **b.** Then in 2014, ANA's second edition of *Nursing Informatics: Scope and Standards of Practices* presented an updated definition: Nursing informatics (NI) is a specialty that integrates nursing science with multiple information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice. NI supports consumers, patients, nurses, and other healthcare professionals in their decision making in all roles and settings to achieve desired outcomes. This support is accomplished through the use of information structures, information processes, and information technology

14. These multiple definitions illustrate the dynamic, developing nature of this still-young nursing specialty
15. Development of different definitions and a healthy debate on those definitions promotes validation of key elements and concepts
16. A willingness to continue exploring possible definitions can prevent premature conceptual closure, which may lead to errors in synthesis and knowledge development

Discussion Point

Ask the student to discuss, if they agree or disagree with, "a willingness to continue exploring possible definitions can prevent premature conceptual closure, which may lead to errors in synthesis and knowledge development." Do they agree or disagree?

What do the students suggest as the next definition for nursing informatics?

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Nursing Informatics as a Specialty

1. Characteristics of a nursing specialty include
   a. Differentiated practice
   b. A well-derived knowledge base
   c. A defined research program
   d. Organizational representation
   e. Educational programs
   f. Credentialing mechanism
2. In 1992, the ANA recognized nursing informatics as a specialty in nursing with a distinct body of knowledge
   a. Unique among the healthcare professions
   b. This designation as a specialty provides official recognition that nursing informatics is indeed a part of nursing and that it has a distinct scope of practice
3. The core phenomena of nursing are the
   a. Nurse
   b. Person
   c. Health
   d. Environment
4. Nursing informatics focuses on the information of nursing needed to address these core phenomena
5. Within this focus are the meta-structures or overarching concepts of nursing informatics
   a. Data
   b. Information
   c. Knowledge
   d. Wisdom
6. It is this special focus on the information of nursing that differentiates nursing informatics from other nursing specialties
7. Research programs in NI are guided by the research priorities set by National Institute for Nursing Research (NINR)
   a. These priorities were first identified in 1993
   b. The priorities include
      (1) Using data, information, and knowledge to deliver and manage care
      (2) Defining and describing data and information for patient care
      (3) Acquiring and delivering knowledge from and for patient care
      (4) Investigating new technologies to create tools for patient care
      (5) Applying patient care ergonomics to the patient-nurse-machine interaction
      (6) Integrating systems for better patient care
      (7) Evaluating the effects of nursing informatics solutions
8. Nursing informatics is represented in international, national, regional, and local organizations

Teaching Tip

Provide the following example, there is a nursing informatics (NI) working group in the American Medical Informatics Association (AMIA) and the International Medical Informatics Association (IMIA). NI is part of the clinical section of the Healthcare Information and Management Systems Society (HIMSS). The International Council of Nurses regularly addresses NI issues and NI use in nursing practice.

9. Increasingly, nursing school curricula include content, and sometimes complete courses, on information technologies in healthcare and nursing
   a. In 1989, the University of Maryland established the first graduate program in nursing informatics
   b. The University of Utah followed in 1990
   c. Now there are several in-person and online programs for graduate work in this specialty
   d. Doctoral programs in nursing informatics have been established
10. The American Nurses Credentialing Center (ANCC) established a certification process and examination in 1995 to recognize those nurses with basic informatics specialty competencies
11. The American Nurses Credentialing Center (ANCC) has used scholarship on nursing-informatics competencies and its own role-delineation studies to develop and maintain the nursing-informatics certification examination
12. The ANCC-designated NI content-expert panel has oversight responsibility for the content of this examination and considers the current informatics environment and research when defining the test-content outline
13. The test-content outline is available for free on the ANCC website

Teaching Tip

Ask the students to explore the ANCC website to learn more about the certification process and the examination. Ask the students to report their findings back to the class.

14. The Healthcare Information and Management Systems Society (HIMSS) established a certification program, known as the certified professional in healthcare information and management systems (CPHIMS), which may be of interest to informatics nurses
15. Two other informatics-related certification programs are offered by the American Health Information Management Association (AHIMA)
    a. The first certification is as a registered health information administrator (RHIA)
        (1) RHIA manages patient health information and medical records, administers computer information systems, collects and analyzes patient data, and uses various classification systems and medical terminologies
        (2) The second AHIMA certification is as a registered health information technician (RHIT)
        (3) In this specialty, professionals ensure the completeness and accuracy of patient data entered into computer systems and focus on coding of diagnoses and patient procedures

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Models for Nursing Informatics

1. The foundations of nursing informatics are the core phenomena and nursing-informatics models
2. The core phenomena are data, information, knowledge, and wisdom and the transformations that each of these undergo
3. Models are representations of some aspect of the real world
4. Models show particular perspectives of a selected aspect and may illustrate relationships
5. Models evolve as knowledge about the selected aspect changes and are dependent on the “worldview” of those developing the model
6. It is important to remember that different models reflect different viewpoints and are not necessarily competitive, that is, there is no one “right” model

Teaching Tip
Ask the students to review the clinical information system (CIS) model that shows how modeling can be used to organize different concepts into a logical whole. The purpose of this model is to depict system components, influencing factors, and relationships that need to be considered when attempting to capture the complexities of professional nursing practice.

7. Different scholars in nursing informatics have proposed different models
8. Some of these models are presented here to provide further perspectives on nursing informatics, to demonstrate how differently scholars and practitioners may view what seems to be the same thing, and to show that nursing informatics is an evolutionary, theoretical, and practical science
9. Graves and Corcoran’s (1989) seminal work included a model of nursing informatics
    a. Their model placed data, information, and knowledge in sequential boxes with one-way arrows pointing from data to information to knowledge
    b. The management processing box is directly above, with arrows pointing in one direction from management processing to each of the three boxes
    c. The model is a direct depiction of their definition of nursing informatics
10. In 1986, Patricia Schwirian proposed a model of nursing informatics intended to stimulate and guide systematic research in this discipline
    a. Her concern was over the sparse volume of research literature in nursing informatics
    b. The model provides a framework for identifying significant information needs, which in turn can foster research
    c. In this model, there are four primary elements arranged in a pyramid with a triangular base
    d. The four elements are the
        (1) Raw material (nursing-related information)
        (2) Technology (a computing system comprised of hardware and software)
        (3) Users surrounded by context (nurses, students)
        (4) Goal (or objective) toward which the preceding elements are directed
    e. Bidirectional arrows connect the three base components of raw material, user, and computer system to form the pyramid’s triangular base
    f. The goal element is placed at the apex of the pyramid to show its importance
    g. All interactions between the three base elements and the goal are represented by bidirectional arrows
11. Turley, writing in 1996, proposed another model
    a. In which the core components of informatics (cognitive science, information science, and computer science) are depicted as intersecting circles
    b. Nursing science is a larger circle that completely encompasses the intersecting circles
    c. Nursing informatics is the intersection between the discipline-specific science (nursing) and the area of informatics
12. McGonigle and Mastrian developed the foundation of knowledge model
    a. The base of this model shows data and information distributed randomly
    b. From this base, transparent cones grow upward and intersect
    c. The upward cones represent acquisition, generation, and dissemination of knowledge
    d. Knowledge processing is represented by the intersections of these three cones
    e. Circling and connecting all of the cones is feedback
    f. The cones and feedback circle are dynamic in nature

Discussion Tip
Ask the students to compare and contrast the models of Graves and Corcoran, Schwirian, Turley, as well as McGonigle and Mastrian.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Theories Supporting Nursing Informatics

1. **Overview**
   - **a.** A theory is a scholarly, organized view of some aspect of the world (reality)
     - **(1)** Theories can describe, explain, predict, or prescribe selected phenomena within this reality
     - **(2)** The concepts within a theory are interrelated
     - **(3)** Testing of these relationships through research is how theories gain or lose supporting evidence
     - **(4)** A profession needs theories to build evidence for the existence of a unique body of knowledge
   - **b.** Theories can be classified as grand, middle-range, and situation-specific or practice theories
     - **(1)** Grand theories are broad in scope and the most complex of the three classifications
     - **(2)** Practice theories are the most specific of the three
     - **(3)** These theories usually provide prescriptions or directions for practitioners
     - **(4)** Middle-range theories are somewhere in the middle of these two ends—they are more specific than grand theories but not as prescriptive as practice theories
   - **c.** Theories are part of an interrelated, circular triad: research, theory, and practice
     - **(1)** Entry into this triad can occur at any point

Teaching Tip
Provide the example, research leads to the development of theory, which can be applied to practice. Alternatively, practitioners can raise questions about clients and/or activities related to clients, which leads to research that generates theory. As pointed out earlier, theory generates research for testing. Validation of a theory can guide practice.

   - **d.** Theories related to and supportive of nursing informatics are numerous
     - **(1)** These theories include—but are not limited to
       - **i.** Information
       - **ii.** Cognitive
       - **iii.** Computer science
       - **iv.** Systems
       - **v.** Change
       - **vi.** Adult-learning
       - **vii.** Organizational behavior
       - **viii.** Management
       - **ix.** And group dynamics
2. **Nursing Theories**
   - **a.** Nursing theories are about nursing practice—a nurse's interactions or relationships with individuals, groups, or communities (also known as patients or clients) focused on applying the nursing process
     - **(1)** Grand nursing theories discuss nursing practice in broad terms, providing different worldviews of how, when, and why nurses relate to clients
     - **(2)** Middle-range nursing theories might describe a particular phenomenon of interest to nurses, explain how one phenomenon relates to one or more other phenomena, or predict how a phenomenon impacts nurses and/or clients
     - **(3)** A particular approach to breast feeding or a set of specific principles for the care of preterm infants that improves their health outcomes are two examples of practice theories in nursing
     - **(4)** Any nursing theory might be useful for an informatics nurse, since informatics nurses work with individuals, groups, and communities
     - **(5)** It is beyond the scope of this chapter to examine particular theories and how they can be applied
     - **(6)** Informatics nurses are encouraged to consult the numerous texts on nursing theory
3. **Novice to Expert**
   - **a.** In 1989, Dreyfus and Dreyfus published a model on how people in a profession become experts
     - **(1)** They proposed five stages: novice, advanced beginner, competent, proficient, and expert
     - **(2)** Patricia Benner and other nurse educators adapted this model to explain how nursing students and professional nurses acquired nursing skills
     - **(3)** A novice follows rules provided for each situation and is not flexible in real-life situations
     - **(4)** As a novice acquires real-life experiences and can appreciate environmental influences on rule sets, he or she moves to the advanced-beginner stage
     - **(5)** At the competent stage, a learner is able to tell what is important and what is not important in assessing a given situation—a learner has gained perspective
     - **(6)** A proficient practitioner is able to see a situation in terms of the larger setting or environmental situation and begins to use intuition in decision making
     - **(7)** Finally, an expert intuitively understands a situation and immediately connects action to this understanding
4. **Computer Science**
   - **a.** Computer science is the study of algorithms for solving computation problems
     - **(1)** If an algorithm can be identified for solving a particular problem, an automated solution to the problem can be developed

    (2) Once an automated solution is developed, a machine can be built (or a person can be hired) to carry out the solution without the person or machine needing to understand the solution
    (3) A computer is a tool of this science, not its focus
  b. Computer science has many subfields
    (1) Some emphasize computation of specific results (such as computer graphics), while others relate to properties of computational problems (e.g., computational complexity)
    (2) Others focus on the challenges in implementing computations

Teaching Tip

Provide the example, programming-language theory studies ways to describe computations; computer programming applies specific programming languages to solve specific computational problems. Despite its name, computer science rarely involves the study of computers themselves. A computer is a tool of this science, not its focus. Computer science research has often crossed into other disciplines, such as artificial intelligence, cognitive science, physics, information science, and linguistics.

5. **Information Science**
  a. Information science focuses on the gathering, manipulation, classification, storage, and retrieval of recorded knowledge
    (1) Information science can be socially oriented, focused on humans and machines, and closely linked to communications and human behavior
    (2) Information science tries to understand problems from the perspective of the stakeholders and applies information and technology as needed to solve the problems
    (3) Three important branches of information science are
      i. Information retrieval
      ii. human–computer interactions—from the perspective of knowledge manipulation
      iii. and information handling within a system (human or machine)
  b. For classic information theory, a central problem has been the engineering problem of the transmission of information over a noisy channel
    (1) The decisive event which established the discipline of information theory, and brought it to immediate worldwide attention, was the publication of Shannon's classic paper, "A Mathematical Theory of Communication," in the *Bell System Technical Journal* in 1948
    (2) Soon after this publication, Weaver coauthored a book with Shannon titled *The Mathematical Theory of Communication*
    (3) This work introduced the concept of the communication channel
    (4) This communication channel consists of a sender (a source of information), a transmission medium (with noise and distortion), and a receiver (whose goal is to reconstruct the sender's messages)
  c. Another core concept is encoding and decoding. If the amount of information to be transmitted exceeds the channel capacity, there are unavoidable and uncorrectable errors in the transmission
    (1) If the amount of information to be sent is below the channel capacity, there is a way to encode the information so that it can be received without errors
    (2) Once encoded, the receiver has to decode the message
  d. These authors, for the first time, introduced the qualitative and quantitative model of communication as a statistical process underlying information theory, opening with the assertion that "The fundamental problem of communication is that of reproducing at one point, either exactly or approximately, a message selected at another point"

6. **Communication**
  a. Communication theory uses these core concepts and additional principles developed since then to analyze information transfer and the effectiveness and efficiency of communications
    (1) If the sender's entropy rate is below the channel capacity, there is a way to encode the information so that it can be received without errors
    (2) This is true even if the channel distorts the message during transmission
  b. Within a communication model, Bruce I. Blum presented a taxonomy, with definitions, of the central concepts of data, information, and knowledge
    (1) These are the concepts adopted by NI
    (2) Blum defined data as discrete entities that are described objectively without interpretation
    (3) That is, the facts, without context
    (4) Data are sometimes referred to as being "raw"
    (5) Information is data that are interpreted, organized, or structured
    (6) It brings in the idea of processing data so that it can be displayed or presented for human use
    (7) Knowledge is information that has been synthesized so that interrelationships of data and information are identified and formalized
    (8) Many informatics theorists have added the concept of Wisdom to Blum's theory
    (9) Think of wisdom as the appropriate use of knowledge in managing and solving problems
    (10) As noted earlier, these terms are on a continuum of simple to complex, beginning with data and proceeding toward wisdom

7. **Cognitive Science**
  a. At its most basic, cognitive science is the study of the mind—of how we think
    (1) Another way of saying this is that cognitive science looks at mental activities and processes
    (2) This science is broad in scope and in the sciences it encompasses
    (3) Cognitive technologies, including computers, smartphones, and Web browsers, are media emerging

from cognitive science that help in learning, memory, problem solving, and living daily life in modern society

(4) Cognitive enhancements of biological-based intelligence and so-called artificial intelligence are two significant branches of these technologies

8. Systems

a. Systems theory relates to the properties of systems as a whole

- **(1)** Systems theory focuses on the organization and interdependence of relationships within a system
- **(2)** A system is any set (group) of interdependent or temporarily interacting parts
- **(3)** Parts are systems themselves and are composed of other parts
- **(4)** The boundary of a system may be open or closed
- **(5)** A closed system has an impermeable boundary and does not interact with the surrounding environment

Teaching Tip

For example, an example of a closed system is the human circulatory system. The circulatory system is considered closed because the blood never leaves the system of blood vessels.

b. An open system can be influenced by events outside of the actual or conceptual boundaries

- **(1)** Open systems usually have semipermeable boundaries that restrict the exchange of selective components but allow free exchange of all other components
- **(2)** An open system interacts with the surrounding environment
- **(3)** Information systems and people are usually considered open systems, although there can be closed systems within these open systems (e.g., the circulatory system)

c. The basic model of a system is one of input crossing the boundary, processing of the input through the system (throughput) and the emergence through the system boundary of some kind of output

- **(1)** Along with this basic model, there are other common elements to every open system
- **(2)** These are feedback, control, environment, and goal

d. Systems are constantly changing

- **(1)** There are six key concepts related to understanding system change
  - **i.** Dynamic homeostasis
  - **ii.** Entropy
  - **iii.** Negentropy
  - **iv.** Specialization
  - **v.** Reverberation
  - **vi.** And equifinality
- **(2)** Dynamic homeostasis preserves the character of a system through its growth
- **(3)** From an organizational perspective, look at this concept by considering that open organizational systems use internal review processes to modify their environmental scanning, input, transformation, and output processes in order to adapt to the changing environment, while still staying focused on their core competency
- **(4)** These modifications lead to quantitative and qualitative growth of an organization's ability to respond to future events
- **(5)** The same processes hold true for organizational programs and projects such as information-system implementation

e. While there are many definitions of entropy, all seem to point in the same direction—entropy is disorder or breaking down into the smallest part

- **(1)** In communication theory, entropy is a measure of the loss of information in a transmitted message
- **(2)** Reverberation is the idea that when one part of a system changes, other parts of the system are affected
- **(3)** The effects on other parts of the system can lead to expected and unexpected consequences
- **(4)** Equifinality is the principle by which a system can get to the same end (or goal) from various different routes
- **(5)** That is, the same inputs can result in the same outputs but by different processes
- **(6)** If you (as a subsystem) are required to obtain a book via input from the system (e.g., a course on informatics), you may return to the system with the book (a form of output) that you may have picked up from a friend, a bookstore, or a library

9. Behavioral and Social Sciences

a. The study of behavior—the processes driving actions—is the focus of the behavioral and social sciences

- **(1)** These two terms, behavioral and social, are often combined or used interchangeably when examining how people act alone (as individuals) and with others
- **(2)** Behavior can include emotions, cognition, and motivation
- **(3)** Social processes and acts can be status (demographic, economic, or cultural), levels of social context, and biosocial interactions

10. Change

a. Change is disruptive, messy, and complicated

- **(1)** Even with the best laid plans, events rarely occur exactly as they were predicted
- **(2)** In healthcare informatics and nursing informatics, change most often has to be dealt with among groups of people and healthcare organizations
- **(3)** Change processes entail not only structures and ways of doing tasks, but also the performance, expectations, and perceptions of all involved parties

b. The informatics nurse specialist (INS) is often the primary change agent in facilitating the implementation of clinical information systems (CIS) in healthcare settings

- **(1)** The INS has a unique understanding of the nursing issues that can affect the change process, and thus, is in a key position to facilitate positive implementation outcomes

c. A study of change processes and change theories will show many models and theories of planned change
  (1) A planned-change theory is a collection of ideas about modifications to an organization or social system that are explicitly designed and put into place
  (2) That is, the changes do not happen by chance
  (3) These theories provide overall guidance for change-agent efforts
  (4) Two of the most familiar perspectives are Lewin's theory on planned change and the diffusion-of-innovations model developed by Rogers

d. Lewin's basic planned-change model has three stages: unfreezing, changing, and refreezing
  (1) Unfreezing involves overcoming inertia and dismantling the existing mind-set
  (2) Defense mechanisms or resistance patterns have to be bypassed
  (3) Measuring the perceptions of those who will experience the change is an important part of this stage
  (4) A change agent must uncover reasons or rewards that will be influential in unfreezing or changing a behavior—that is, what is important to the people

Teaching Tip
To apply this idea to nursing informatics, consider an information-system implementation. In this situation, the identified reasons or rewards can be used to help convert behavioral intent (e.g., people considering adopting the system) to actual behavior (people become active system users).

e. In the second stage, called moving, the behavioral change occurs
  (1) Typically, this stage is a period of confusion
  (2) People are aware that the old ways are being challenged but do not yet have a clear picture of how to replace the old ways
  (3) The third—final—stage is "refreezing"
  (4) A new mind-set has formed, and the comfort level is returning to previous levels

f. Diffusion of innovation looks at how, why, and at what rate new ideas and technologies spread through cultures
  (1) It is examination of the process for communicating an innovation throughout a social system

g. Everett Rogers formalized the diffusion-of-innovations theory in a 1962 book called *Diffusion of Innovations*
  (1) In his work, Rogers identified five specific groups of innovation adopters
  (2) These groups are known as
    i. Innovators
    ii. Early adopters
    iii. Early majority
    iv. Late majority
    v. And laggards

h. The distribution (or percentage of each category in a population) approximates a bell curve

i. Each adopter's willingness and ability to adopt an innovation would depend on their
  i. Awareness
  ii. Interest
  iii. Evaluation
  iv. Trial
  v. And adoption

j. Rogers also presented characteristics for each category of adopter

k. Along with the concept of different categories of innovation adopters, Rogers proposed a five stage model for the diffusion of innovation:
- Stage 1 is knowledge—learning about the existence and function of the innovation
- Stage 2 is persuasion—becoming convinced of the value of the innovation
- In Stage 3, the adopter makes a decision—committing to the adoption of the innovation
- Implementation—putting it to use—is Stage 4
- The final Stage is confirmation—the ultimate acceptance (or rejection) of the innovation

Teaching Tip
How does this theory apply to the work of an informatics nurse? Understanding the social forces underlying innovation diffusion is critical for effective management of the process of implementing an informatics innovation, such as a healthcare information system.

l. Because of the investment of time, energy, and economic resources in implementing an information system, organizations—and the people involved in the implementation—must be aware of the human elements influencing successful implementation and subsequent adoption
  (1) To be adopted, innovations must appeal to people
  (2) People must see something in an innovation that they like or want

m. Rogers also identified characteristics of an innovation that most affect the rate of adoption
  (1) These characteristics are
    i. Relative advantage
    ii. Compatibility
    iii. Complexity
    iv. Trialability
    v. And observability

n. Relative advantage refers to the degree to which an innovation is perceived as better than the idea it replaces
  (1) This is a positive characteristic
  (2) Another positive characteristic is compatibility
  (3) Compatibility is the degree to which an innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters
  (4) Complexity, as defined by Rogers, is a negative characteristic

- **(5)** It is the degree to which an innovation is perceived as difficult to understand and use
- **(6)** Trialability, another positive characteristic, is the degree to which an innovation may be tried out or experimented with
- **(7)** The last characteristic, observability, is the degree to which the results of an innovation are visible to others
- **(8)** It also is a positive characteristic
- **(9)** In summary, Rogers asserts that innovations perceived by potential adopters as having greater relative advantage, compatibility, trialability, and observability, and less complexity will be adopted more rapidly than other innovations
- **(10)** In other words, the adoption of an innovation by an individual depends on how the individual perceives that innovation

11. Learning

- **a.** Learning is a process of acquiring knowledge, skills, attitudes, or values through study, experience, or teaching
  - **(1)** Learning causes a change in behavior that is persistent, measurable, and specified
  - **(2)** Learning allows someone to formulate a new mental construct or revise a prior mental construct
  - **(3)** There are numerous theories addressing how people learn
  - **(4)** Obviously, it is beyond the scope of this chapter to delve into all these theories
  - **(5)** A look at categories of these theories will help guide further study
  - **(6)** One approach is to categorize learning theories as behavioral, cognitive, adult learning, and learning styles
- **b.** Behaviorists believe that learning processes can be studied more objectively when the focus is on stimuli and responses (also known as operant conditioning)
  - **(1)** At a very simplistic level, think of this learning approach as having two basic elements
  - **(2)** First, there is a pairing—a combination of a stimulus with a response
  - **(3)** Then, there is reinforcement, which is the stimulus-response element that has two pathways
  - **(4)** One is positive reinforcement in which every stimulus is followed by something pleasant or in which the stimulus itself is a good experience
  - **(5)** This positive experience encourages continued learning
  - **(6)** The other pathway is negative reinforcement where learners may associate a stimulus with unpleasant or painful experiences
- **c.** Cognitive learning theory focuses on internal mental processes, including insight, information processing, memory, and perception
  - **(1)** Cognitivists attempt to model how information is
    - **i.** Received
    - **ii.** Assimilated
    - **iii.** Stored
    - **iv.** And recalled
  - **(2)** Cognitive learning theory divides learning (or to be more precise, it divides information processing), into four steps
  - **(3)** These are
    - **i.** Information input (information is received by the learner)
    - **ii.** Input processing (the information is either remembered only for a short time or is moved to long-term memory where it can be drawn upon as needed)
    - **iii.** Output behaviors (that demonstrate if learning has taken place)
    - **iv.** And the use of feedback to embed the same information more firmly or to correct errors
- **d.** Proponents of learning styles theory assert that individuals have a tendency to both perceive and process information differently
  - **(1)** There are concrete and abstract perceivers and active and reflective processors.
  - **(2)** Concrete perceivers absorb information through direct experience by doing, acting, sensing, and feeling
  - **(3)** Abstract perceivers take in information through analysis, observation, and thinking
  - **(4)** Active processors make sense of an experience by immediately using the new information
  - **(5)** Reflective processors make sense of an experience by reflecting on and thinking about it
- **e.** Adult learning theory focuses on understanding how adults learn as opposed to children
  - **(1)** Adult learners bring a great deal of experience to the learning environment
  - **(2)** Educators can use this experience as a resource
  - **(3)** Adults expect to have a high degree of influence on what they are to be educated for and how they are to be educated
  - **(4)** The active participation of learners should be encouraged in designing and implementing educational programs
  - **(5)** Adults need to be able to see applications for new learning
  - **(6)** Adult learners expect to have a high degree of influence on how learning will be evaluated
  - **(7)** Adults expect their responses to be acted upon when asked for feedback on the progress of the program

12. Organizational Behavior

- **a.** Organizational behavior is a distinct field focused on organizations
  - **(1)** In this field, organizations are examined, using the methods drawn from economics, sociology, political science, anthropology, and psychology
  - **(2)** Both individual and group dynamics in an organizational setting are studied, as well as the nature of the organizations themselves
  - **(3)** Organizational behavior is becoming more important in the global economy as people with diverse

backgrounds and cultural values have to work together effectively and efficiently

(4) A healthy organization has a balance, among the participants, of autonomy, control, and cooperation

(5) Understanding how organizations behave, and how a particular organization behaves, can guide planning for information-system implementations

13. Management

a. Management science uses mathematics and other analytical methods to help make better decisions, generally in a business context

(1) While often considered synonymous with operations research (OR), management science is differentiated from OR by a more practical, rather than academic, bent

b. The management scientist uses rational, systematic, science-based techniques to inform and improve decisions of all kinds

(1) Naturally, the techniques of management science are not restricted to business applications, but may be applied to military situations, clinical decision support, public administration, charitable groups, political groups, or community groups

(2) Some of the methods within management science are decision analysis, optimization, simulation, forecasting, game theory, graph theory, network problems, transportation-forecasting models, mathematical modeling, and queuing theory, as well as many others

14. Group Dynamics

a. Group dynamics is a social science field that focuses on the nature of groups

(1) Urges to belong or to identify may make for distinctly different attitudes (recognized or unrecognized), and the influence of a group may rapidly become strong, influencing or overwhelming individual proclivities and actions

b. Within any organization, there are formal and informal groups, each applying pressure on individuals to different degrees

(1) Informal groups have a powerful influence on the effectiveness of an organization, and can even subvert its formal goals

(2) But the informal group's role is not limited to resistance

(3) The impact of the informal group upon the larger formal group depends on the norms that the informal group sets

(4) So the informal group can make the formal organization more effective, too

c. Bruce Tuckman proposed a four-stage model, called Tuckman's stages, for a group. Tuckman's model states that the ideal group decision-making process should occur in four stages

- Forming (pretending to get on or get along with others)
- Storming (letting down the politeness barrier and trying to get down to the issues, even if tempers flare up)
- Norming (getting used to each other and developing trust and productivity)
- And Performing (working in a group to a common goal on a highly efficient and cooperative basis)

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Competencies

1. Benner's work, built on the Dreyfus model of skill acquisition describes the evolution of novice to expert, and merits discussion for nursing informatics
2. This desired change in skills involves the evolution from a novice level to advanced beginner to competent to proficient to, finally, an expert level

Teaching Tip

Provide the following information as an example, every nurse must continually exhibit the capability to acquire and then demonstrate specific skills, beginning with the very first student experience. As students, most individuals can be described as novices having no experience with the situations and related content in those situations where they are expected to begin developing competencies by performing tasks that refine their skills.

The advanced beginner can marginally demonstrate acceptable performance, having built on lessons learned in an expanding experience base. Individuals at these levels often need oversight by teachers or experienced colleagues to help structure the learning experience and support appropriate and successful workplace decision making and action. Increased proficiency over time results in enhanced competencies reflecting mastery and the ability to cope with and manage many contingencies. Continued practice, combined with additional professional experience and knowledge, allows the nurse to evolve to the proficient level of appreciating the rules and maxims of practice and the nuances that are reflected in the absence of the normal picture. The expert has the capacity to intuitively understand the situation and immediately target the problem with minimal effort or problem solving.

3. Staggers, Gassert, and Curran are most often cited as the first published research identifying the informatics competencies necessary for all nurses

a. Their conceptual framework included computer skills, informatics knowledge, and informatics skills as the informatics competencies necessary for all nurses

b. Their research, however, only identified informatics competencies for four levels of nurses: beginning nurse, experienced nurse, informatics specialist, and informatics innovator

c. The comprehensive list of 304 competencies posed a significant challenge for professional development and academic faculties wishing to address each of the competencies when preparing curricula and then teaching educational programs for all skill levels

4. Further competencies definition work was completed by the workgroup that developed the 2008 NI scope and standards document
    a. Their review of the literature culminated in a two-page matrix that included delineation by computer and information literacy
5. The Technology Informatics Guiding Educational Reform (TIGER) initiative moved from an invitational conference to volunteer task forces, also known as collaboratives, to systematically develop key content related to discrete topics, including nursing informatics competencies
6. The TIGER collaborative on competencies focused on the minimum set of competencies needed by every nurse
7. The competencies are organized into three categories
    a. Basic computer skills
    b. Information literacy
    c. And Information management
    d. elements of nursing practice
8. The National League for Nursing (NLN) has developed a set of competencies for nursing educators
    a. These may be found on the NLN website
    b. A recent study presents an updated summary and analysis of other work done on developing nursing-informatics competencies
    c. These authors note variation in content, presentation, and audience among the sets of competencies reviewed
9. Instruments to assess perceived levels of NI competency are emerging in the scholarly literature
    a. Yoon, Yen, and Bakken described the validation of an instrument titled the Self-Assessment of Nursing Informatics Competencies Scale
    b. This scale incorporates selected items from the work of Staggers, Gassert, and Curran along with items addressed in a specific NI curriculum
    c. In 2013, Hunter, McGonigle, and Hebda published the results of validity and reliability testing on an online self-assessment tool entitled TIGER-based Assessment of Nursing Informatics Competencies (TANIC)©
    d. TANIC uses all of the competencies identified by the TIGER Institute
    e. The Level 3 and Level 4 competencies identified by Staggers, Gassert, and Curran were organized into an online instrument by McGonigle, Hunter, Hebda, and Hill
    f. This instrument, titled Nursing Informatics Competencies Assessment Level 3 and Level 4 (NICA L3/L4©), has demonstrated reliability and validity

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Organizations as Resources

1. Provide the following information, many organizations have emerged to provide information resources and value-added membership benefits that support those individuals interested in healthcare and nursing informatics
    a. Clinical specialty and other professional organizations have also appreciated the evolving healthcare information management focus and have established organizational structures such as informatics section
    b. Some have incorporated informatics and information system technology initiatives in strategic plans with dedicated staffing and ongoing financial support
    c. In many instances, informal networking groups have evolved into international organizations with hundreds of members connected via the Web
    d. The nature, purposes, and activities of the multiple informatics organizations have sufficient differences that there is bound to be at least one organization, if not more, for everyone interested in nursing informatics
    e. Information about a few of these organizations is provided here
    f. The information for each group was adapted from each group's website
    g. Only national or international informatics-related organizations with nursing groups are included
    h. All of the groups presented here are accessible to individual nurses for more information and/or participation
    i. This content is in no way an exhaustive presentation
    j. To learn more about these organizations and others, consult the Internet, informatics colleagues, and the scholarly literature
2. **American Nurses Association (ANA) and Specialty Nursing Organizations**
    a. The ANA and its affiliates and several nursing specialty organizations have informatics committees and government affairs offices addressing information technology, EHRs, standards, and other informatics issues
    b. Membership and active participation in such professional organizations demonstrate compliance with Provisions 8 and 9 of the *Code of Ethics for Nurses with Interpretive Statements* and Standard 16
    c. Standard12: Leadership described in *Nursing Informatics: Scope and Standards of Practice, Second Edition*
    d. Within the ANA, the CNPII provides the major policy generation and management for informatics-related topics and issues
3. **AMIA Nursing Informatics Working Group (NIWG)**
    a. AMIA is a nonprofit membership organization of individuals, institutions, and corporations dedicated to developing and using information technologies to improve healthcare
    b. The NIWG within AMIA aims to promote and advance nursing informatics within the larger context of health informatics
    c. The NIWG pursues this mission in many areas, such as professional practice, education, research, governmental and other service, professional organizations, and industry
    d. Member services, outreach functions, official representation to Nursing Informatics Special Interest Group of the

International Medical Informatics Association (IMIA-NI) and liaison activities to other national and international groups are some of the activities of this working group

- **e.** NIWG has established three awards that recognize excellence in nursing informatics
  - **(1)** The Student Award
  - **(2)** The Harriet Werley Award
  - **(3)** The Virginia K. Saba Informatics Award

4. **American Nursing Informatics Association (ANIA)**
   - **a.** In January 2010, two nursing informatics organizations (American Nursing Informatics Association and CARING) merged to form ANIA
   - **b.** The combined organization, with a 3000-plus membership in 50 states and 34 countries
   - **c.** Is one of the largest associations of its kind in the United States
   - **d.** The organization is dedicated to advancing the field of nursing informatics through communications, education, research, and professional activities
   - **e.** There is an annual sprig conference
   - **f.** A newsletter is published quarterly and is indexed in CINAHL and Thompson
   - **g.** ANIA runs a very active e-mail list and provides public access to a large job bank, listing over 800 employer-paid positions
5. **British Computer Society (BCS) Nursing Specialist Group (NSG)**
   - **a.** The BCS promotes wider social and economic progress through the advancement of information technology science and practice
   - **b.** The Nursing Specialist Group (NSG) is one of five health informatics specialist groups (HISGS) within the BCS
   - **c.** NSG contributes to national and international debates on information-management and information-technology issues within healthcare. NSG converses and collaborates with other nursing groups within the United Kingdom and with international informatics groups
   - **d.** The NSG contributes to the annual Healthcare Computing (HC) Conferences run by the BCS Health Informatics Committee (HIC), supplemented by special topic meetings organized by the various focus, geographic and affiliated groups
6. **HIMSS Nursing Informatics Community**
   - **a.** The Healthcare Information and Management Systems Society (HIMSS) provides leadership for the management of healthcare-related technology, information, and change through publications, educational opportunities, and member services
   - **b.** The HIMSS Nursing Informatics Community reflects the increased recognition of the role of the informatics nurse professional in healthcare information and management systems
   - **c.** This community speaks in a unified voice for the HIMSS members who practice in the nursing informatics community and provides nursing informatics expertise, leadership, and guidance internally to HIMSS and externally with the global nursing informatics community
   - **d.** The HIMSS Nursing Informatics Committee serves as the leadership for this community
   - **e.** The Nursing Informatics Community has a membership of more than 2000 nurses, representing nearly 10% of HIMSS members
7. **NLN Educational Technology and Information Management Advisory Council (ETIMAC)**
   - **a.** The mission of the National League for Nursing (NLN) is to advance quality nursing education that prepares the nursing workforce to meet the needs of diverse populations in an ever-changing healthcare environment
   - **b.** This advisory group within NLN functions to promote the use of educational technology as a teaching tool to advance the informatics competencies of faculty, integrate informatics competencies into nursing school curricula, promoting the development of nursing-education information-management systems, advise professional organization and other groups about informatics competencies, and collaborate with other NLN advisory councils and groups
8. **Nursing Informatics Australia (NIA)**
   - **a.** The NIA is a special interest group (SIG) of the Health Informatics Society of Australia (HISA)
   - **b.** The NIA sees the priorities for nursing informatics in Australia as appropriate language, education, and ongoing research
   - **c.** It aims to encourage nurses to embrace information and communication technologies and to establish strong foundations for taking these developments forward
   - **d.** The NIA works to ensure nursing has the data and resources to continue providing evidence-based, quality, cost-effective, and outcome-driven care for patients and clients into the future
   - **e.** The NIA holds an annual conference on nursing informatics
9. **Nursing Informatics Special Interest Group of the International Medical Informatics Association (IMIA/NI-SIG)**
   - **a.** This SIG was originally established by IMIA in 1983 as Working Group 8 of IMIA
   - **b.** Dedicated to serving the specific needs of nurses in the field of nursing informatics
   - **c.** IMIA-NI focuses on
   - **d.** Fostering collaboration among nurses and others who are interested in nursing informatics
   - **e.** Exploring the scope of nursing informatics and its implication for information handling activities associated with the delivery of nursing care, nursing administration, nursing research, and nursing education
   - **f.** Supporting the development of nursing informatics in the member countries
   - **g.** Providing appropriate informatics meetings, conferences, and post-conferences to provide opportunities to share knowledge-sharing opportunities
   - **h.** Encouraging dissemination of nursing informatics research findings
   - **i.** Developing recommendations, guidelines, and courses related to nursing informatics

10. **Alliance for Nursing Informatics (ANI)**
    a. The ANI is a collaboration of organizations that provides a unified voice for nursing informatics
    b. NI brings together over 25 nursing informatics groups mainly in the United States that function separately at local, regional, national, and international levels
    c. Each of these organizations has its own established programs, publications, and organizational structures
    d. ANI envisions the transformation of health and healthcare through nursing informatics and innovation
    e. Its mission is advancing nursing-informatics, leadership, practice, education, policy, and research through a unified voice
11. **TIGER (Initiative Foundation)**
    a. TIGER is the acronym, standing for Technology Informatics Guiding Education Reform
    b. The TIGER Initiative, a collaboration of individuals and organizations, was created to better enable practicing nurses and nursing students to use information technology and informatics to improve patient care delivery
    c. The focus of TIGER is to improve the pre-licensure and post-licensure informatics education of registered nurses
    d. TIGER produced a series of collaborative reports describing the current state of affairs for seven critical areas of informatics education proposing action plans for improving these areas
    e. The TIGER Initiative Foundation was formed in 2011 to carry on this work
12. **Canadian Nursing Informatics Association (CNIA)**
    a. The Canadian Nursing Informatics Association (CNIA) is organized to help Canadian nurses learn about informatics and share, research, and create informatics related projects and experiences
    b. The results of these endeavors will be to boost the competencies, theory, and practice of nursing informatics across Canada
    c. The mission of CNIA is to be the voice for nursing informatics in Canada
    d. Recognizing the importance of the work the CNIA is undertaking, the Canadian Nurses Association has granted associate group status to the CNIA
    e. The CNIA is also affiliated with COACH, Canada's Health Informatics Association and the IMIA/SIG-NI
13. **American Academy of Nursing (AAN)**
    a. Expert Panel on Nursing Informatics
    b. This expert panel gathers and disseminates health-policy data and information and advises and represents the AAN on issues related to health-information management, implementation of informatics and information technology through EHRs and PHRs (electronic and personal health records), HIPAA, patient-safety initiatives, consumer and personal health, workforce issues and training, bioterrorism and bio-surveillance, evidence-based practice, clinical-decision support, and other areas of concern related to the use of informatics and information technology in nursing education, practice, administration, and research
14. **Sigma Theta Tau International (STTI)**
    a. Sigma Theta Tau International's mission is to support the learning, knowledge, and professional development of nurses who are committed to making a difference in health worldwide
    b. It has established the Virginia K. Saba Nursing Informatics Leadership Award given to an informatics expert whose contributions have the capacity and scope to enhance quality, safety, outcomes, and decision making in health and nursing care from a national or an international perspective
    c. The Ruth Lilly Nursing Informatics Scholar is a 2-year award to an individual to contribute to the vision and plan for the Virginia Henderson International Nursing Library's continued contributions to nursing knowledge
    d. STTI is a collaborator in the work of the TIGER Initiative Foundation

Discussion Tip

Ask the students to compare and contrast the various nursing informatics organizations. Ask the students they are members of a nursing informatics organization. Ask the students about the benefit they receive from membership.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Scope of Practice and Standards of Practice

1. Overview
    a. The American Nurses Association (ANA) provides the definition of nursing and is the steward of the nursing profession's foundational documents: the nonnegotiable *Code of Ethics for Nurses With Interpretive Statements* and *Nursing: Scope and Standards of Practice, Second Edition*
        (1) ANA, in its role as the professional organization for all registered nurses (RNs) and advanced practice registered nurses (APRNs), also serves as the convening body to facilitate the development and scheduled revision of select specialty-nursing scope of practice statements and accompanying standards of practice
        (2) This section provides the history of such ANA action related to the development and recognition of nursing informatics as a nursing specialty
        (3) More detailed descriptions of the nursing informatics scope and standards of practice content follow
2. **Nursing Informatics Scope of Practice Statement**
    a. The current, detailed nursing informatics scope-of-practice statement available in *Nursing Informatics: Scope and Standards of Practice, Second Edition,* provides the definition of nursing informatics and builds on the content incorporated in ANA's 2001 *Code of Ethics for Nurses With Interpretive Statements* and 2010 *Nursing: Scope and Standards of Practice, Second Edition*
        (1) Such a nursing scope of practice statement is expected to adequately answer six questions: who, what, when,

where, how, and why; so the readers can close their eyes and easily envision an informatics nurse and nursing informatics practice

  - **(2)** Thoughtful and precise descriptive answers to the six questions in the narrative scope of practice statement provide clarity to enhance understanding about the demonstrated passion of the informatics nurse and informatics nurse specialist, practice characteristics, and professional expectations
  - **(3)** Professional colleagues, educators developing curricula and teaching the requisite nursing informatics content, administrators and employers, researchers, healthcare consumers, regulatory and credentialing authorities, and others find such details helpful

- **b.** This specialty's registered nurses who have an interest in nursing informatics, have experience, and have been educationally prepared at a baccalaureate level, are identified as informatics nurses (INs)
  - **(1)** The informatics nurse specialist (INS) is a registered nurse with additional formal graduate-level education in informatics or related fields
  - **(2)** The available nursing informatics board-certification credentialing option can be obtained and maintained by qualified individuals who meet defined criteria, pass an initial certification examination, and complete continuing-education and work-hour requirements
  - **(3)** Certification renewals must be completed every 5 years and require evidence of continuing education and lifelong learning experiences as well as attestation of the required number of informatics-practice hours
- **c.** Informatics nurses assume a plethora of titles in their work environments
  - **(1)** The diversity of position titles for informatics nurses encountered within the nursing-services sector is equivalent to the multitude of titling conventions present in the healthcare or corporate information-systems/services divisions
  - **(2)** Informatics nurses who bravely embark on entrepreneurial opportunities often create very distinct titles
  - **(3)** Examination of job posting/career opportunities boards and services similarly reflect numerous titles that give little inkling of how an informatics nurse might be a stellar candidate
  - **(4)** Therefore, the nursing informatics scope-of-practice authors elected to focus on the characteristics, knowledge, skills, and abilities informatics nurses bring to every setting and role
- **d.** Further description of the "who" in nursing informatics addresses the recipient of the informatics nurse's and informatics nurse specialist's actions, decisions, and interactions
  - **(1)** Professional colleagues, educators developing curricula and teaching the requisite nursing informatics content, administrators and employers, researchers, healthcare consumers, regulatory and credentialing authorities, and others have occasion to interact with informatics nurses
  - **(2)** Such interactions include the expectation that the IN and INS easily transition between leader and member roles within interprofessional teams in all practice settings
  - **(3)** Note that the IN and INS are most often the individuals who ensure the interprofessional team includes healthcare consumers and redirect the focus to patient/healthcare-consumer centricity
- **e.** Diversity, change, and innovation best characterize the activities, decision-making, concerns, foci, goals, and outcomes of nursing informatics practice
  - **(1)** Every day, and sometimes every hour, generates unique challenges and opportunities
  - **(2)** Perceived barriers need to be addressed and minimized to "speed bump" levels
  - **(3)** The "what" so often includes complex, disparate components of a dysfunctional system or enterprise
  - **(4)** Nursing informatics practice also addresses the need for assessment, definition, identification of expected outcomes, planning, implementation, and evaluation of the transformation from an "as is" state, condition, or operation to an envisioned and preferred "to be" level or entity
  - **(5)** The data, information, knowledge, and wisdom framework, as well as decision support, analytics, and research, constitute additional components of the scope of nursing informatics
- **f.** The description of timing and sequencing, understanding the history of a project or program, and appreciation of project management and a system's life cycle are exemplars of the "when" component of a scope of practice statement for nursing informatics
  - **(1)** Strategic planning focused on prevention of errors, problems, and unintended consequences, along with attention to effective change management practices and strategies, provide some hope for success in any nursing informatics initiative
  - **(2)** Informatics nurses rely on their rich history of attention to detail to precise timing and sequencing ingrained into practice, beginning in the undergraduate nursing education and practicum experiences related to medication administration, clinical documentation, and care planning
- **g.** The evolution of the nursing informatics specialty has seen an explosion in the location and settings or "where" of nursing informatics practice
  - **(1)** The academic, professional-development, and continuing-education venues have moved from a discrete physical location to a global virtual presence and increasingly embrace online learning programs, gaming, and simulation experiences
  - **(2)** INs and INSs are often key developers and contributors in this space
  - **(3)** A similar evolution has occurred in the clinical environment with the proliferation of telehealth, teleICUs, patient engagement via mobile applications, home-health monitoring, and e-mail and other virtual communications technologies
  - **(4)** The informatics nurse is no longer limited to employment in acute-care settings and can be found in

post-acute and long-term care facilities, public and private school systems, insurance and data-analytics venues, corporate offices, research and development environments, and the exciting world of the entrepreneur

  - **(5)** The organizational charts and reporting structures varies significantly, so informatics nurses may find themselves assigned to nursing or patient services, information technology or information services, quality improvement and risk management, legal counsel, clinical informatics, or other departments, divisions, or entities
  - **(6)** It's not uncommon for the informatics nurse to be assigned to report to supervisors in two divisions, such as nursing services and information-technology services
  - **(7)** The knowledge, skills, and abilities of the IN and INS to be the liaison or translator are invaluable enablers wherever they practice

- **h.** The "how" of nursing informatics begins with the nurse's reliance on the incorporation of the nursing process into all thinking actions and practice activities
  - **(1)** The interrelated and iterative nursing-process steps of assessment; diagnosis, problem, or issue identification; outcomes identification; planning; implementation; and evaluation are reflected in the nursing informatics standards of practice and accompanying competencies described later
  - **(2)** The nursing informatics professional-performance standards and accompanying competencies provide more detail about the expected professional role performance of the IN and INS
- **i.** Nursing informatics practice encompasses a systems perspective where the whole is greater than the sum of its parts
  - **(1)** Proactive and preventive thinking and approaches, like those embraced in the clinical-practice realm, are particularly helpful during assessment, diagnosis, outcomes identification, planning, and implementation activities
  - **(2)** Definition of outcomes is of key importance in any setting and project
  - **(3)** Without such clarity, the IN and INS often must address the ensuing ill-defined plans, floundering implementation activities, and unwanted results
  - **(4)** The IN and INS rely on both project and change-management knowledge and skills to facilitate successful implementation actions for large projects or smaller upgrades or changes
- **j.** In today's healthcare environment, safe, quality, patient-centric, cost-effective, and team-based care is the focus
  - **(1)** The informatics nurse and informatics nurse specialist are the primary and often the only advocates for the patient/healthcare consumer-centric perspective in systems' design, development, testing, implementation, and evaluation environments
  - **(2)** The IN/INS advocacy role also extends to calling for and assuring all stakeholders, including healthcare consumers, are engaged members of the team
  - **(3)** Each IN and INS also has obligations to protect the employer, organization, or enterprise from untoward outcomes
- **k.** The "why" of nursing informatics practice derives from the mandate for all registered nurses to abide by the profession's 2001 *Code of Ethics for Nurses With Interpretive Statements*
  - **(1)** Each of the nine provisions is applicable to nursing informatics practice and is included in the detailed scope of practice statement in the 2014 *Nursing Informatics: Scope and Standards of Practice, Second Edition*
  - **(2)** Standards and best practices for data and information privacy, security, and confidentiality provide detailed direction and guidance for the IN and INS
  - **(3)** Local, state, and federal legislation and regulations provide mandates for compliance and reporting that the informatics nurse and informatics nurse specialist address in daily practice such as reporting morbidity, mortality, and operations details via ICD-10-CM, ICD-10-PCS, CPT4, and DSM-5
  - **(4)** Publication of metrics associated with safety, quality, and achievement of expected outcomes has gained increased importance because of the call for openness and transparency in healthcare-services delivery and the evolution to reimbursement for quality performance
  - **(5)** Often, informatics nurses help develop and maintain the resulting dashboards and reports that provide meaningful details and information to healthcare consumers and healthcare professionals
- **l.** Data, information, and knowledge management strategies and capabilities associated with department, facility, and enterprise reporting are also requisite for identifying and detailing the contributions and impact of nursing, registered nurses, and advanced practice registered nurses in the delivery of local, regional, state, national, and global healthcare services
  - **(1)** Increased public accountability for evidence-based best-practice nursing care requires standardization of metrics and identification and remediation of variances, key concerns for informatics nurses addressing the viability and availability of supporting healthcare information system resources
  - **(2)** Informatics nurses and informatics nurse specialists are integral partners in the innovative development underway and future implementation and reporting for the first electronic quality measure—pressure ulcer incidence and prevention
- **m.** Risk mitigation and concerns about legal issues may prompt informatics nurses to delve more deeply into system security, implementation and monitoring of audit trails, prevention of misuse of data, forensics and e-discovery, corporate or organizational liability, de-identified data and big data analytics, and information governance
  - **(1)** The IN and INS seek to prevent unintended consequences and harm resulting from implementation of healthcare information systems and poorly designed workflows

(2) Each informatics nurse also has the responsibility to contribute as a partner in emergency preparedness and disaster recovery thinking and action to keep the requisite data, information, and knowledge acquisition, management, communication, and storage processing capabilities and actions intact at all times

3. **Standards of Nursing Informatics Practice**
   - **a.** The nursing informatics scope of practice statement provides a very brief narrative description of the significant diversity, magnitude, influence, and impact of this specialty nursing practice
     - **(1)** The accompanying standards of nursing informatics practice content must be considered as integral to practice and includes two sections
     - **(2)** Each standard statement and the accompanying competencies reflect the language and influence of the general standards of practice and professional performance delineated in the 2010 *Nursing: Scope and Standards of Practice, Second Edition*
     - **(3)** Both informatics nurses and informatics nurse specialists are expected to practice in accordance with the standards and demonstrate competence characterized by the accompanying competency statements
     - **(4)** In certain instances, additional competencies are applicable to the informatics nurse specialist and are intended to reflect higher expectations for this role's advanced level of practice
     - **(5)** The detailed competency statements are not intended to be a complete listing and can be supplemented with additional delineated competencies associated with setting, role, or organizational policy
   - **b. Standards of Practice**

Teaching Tip

The Standards of Practice identify how the informatics nurse and informatics nurse specialist are expected to incorporate the nursing process into all thinking and practice activities.

- Standard 1. Assessment addresses the collection of data, information, and emerging evidence as the first step of the nursing process
- Standard 2. Diagnosis, Problems and Issues Identification calls for the informatics nurse to complete an analysis of the data to identify problems and issues; thus, linking Standards 1 and 2
- Standard 3. Outcomes Identification describes how the informatics nurse identifies expected outcomes that then drive development of an individualized plan to achieve those outcomes
- Standard 4. Planning identifies that the informatics nurse develops a plan with prescribed strategies, alternatives, and recommendations aimed at achieving the delineated expected outcomes
- Standard 5. Implementation addresses that the informatics nurse implements the identified plan. Standard 5a. Coordination of Activities, Standard 5b. Health Teaching and Health Promotion, and Standard 5c. Consultation are specifically delineated implementation activities that describe key nursing activities that merit additional attention
- Standard 6. Evaluation speaks about the expectation that the informatics nurse evaluates progress toward attainment of the outcomes. Accompanying competencies affirm collaboration and partnerships are key components in effectively demonstrating such an evaluation

   - **c. Standards of Professional Performance**

Teaching Tip

The Standards of Professional Performance express the role performance requirements for the informatics nurse and informatics nurse specialist.

- Standard 7. Ethics identifies the informatics nurse practices ethically, with further detailing of associated competencies, such as the use of the *Code of Ethics for Nurses with Interpretive Statements* to guide practice
- Standard 8. Education addresses the need for the informatics nurse to attain knowledge and competence, including the competency associated with demonstration of a commitment to life-long learning
- Standard 9. Evidence-based Practice and Research confirms that the informatics nurse integrates evidence and research findings into practice
- Standard 10. Quality of Practice describes the expectation for the informatics nurse's contribution related to the quality and effectiveness of both nursing and informatics practice
- Standard 11. Communication explains that the informatics nurse communicates effectively through a variety of formats, with several accompanying competencies delineating specific requisite knowledge, skills, and abilities for demonstrated success in this area
- Standard 12. Leadership promotes that the informatics nurse leads in the professional practice setting, as well as the profession. Accompanying competencies address such skills as mentoring, problem solving, and promoting the organization's vision, goals, and strategic plan
- Standard 13. Collaboration encompasses the informatics nurse's collaborative efforts with the healthcare consumer, family, and others in the conduct of nursing and informatics practice
- Standard 14. Professional Practice Evaluation identifies that the informatics nurse conducts evaluation of their own nursing practice considering professional practice standards and guidelines, relevant statutes, rules, and regulations
- Standard 15. Resource Utilization addresses that the informatics nurse uses appropriate resources to plan and implement safe, effective, and fiscally responsible informatics and associated services
- Standard 16. Environmental Health closes out the list of professional performance standards by describing that the informatics nurse supports practice in a safe and healthy environment

Teaching Tip

Consult the 2014 Nursing Informatics: Scope and Standards of Practice, Second Edition, for the precise standards and accompanying competencies language that provides additional details about the nursing informatics specialty and its members.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- Concepts of informatics, healthcare informatics, and nursing informatics were explained and their relationships to each other were discussed
- The core concepts of nursing informatics were presented and described. The establishment of the specialty of nursing informatics was explained
- Models of nursing informatics were described, and supporting models and theories were summarized
- Competency work related to the practice of nursing informatics was presented. International and national resources for informatics nurses were provided
- A discussion on how the nursing informatics scope of practice details the "who, what, when, where, how, and why" associated with this specialty was related
- The nursing informatics standards of practice and standards of professional performance were briefly described
- The 2014 *Nursing Informatics: Scope and Standards of Practice, Second Edition* contains the official scope of practice statement, standards, and all accompanying competencies, including additional competencies delineated as applicable for the advanced level of practice of the informatics nurse specialist

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Relate the definition of nursing informatics and its qualifications as a distinct specialty
- Discuss models and theories that support nursing informatics
- Identify available organizational resources
- Describe the relationship of the standards of practice in nursing informatics to the scope of practice statement

Teaching Tip

Ask the students to define the keywords

- Informatics
- Competencies
- Models
- Theory
- Nursing process
- Scope of practice
- Standards of practice
- Standards of professional performance

CHAPTER REVIEW QUESTIONS

Question 15.1: Which best describes the goal of nursing informatics?

a. To provide nurses with the data, information and support for information processing to make effective decisions.
b. To provide programmers with nursing data to process
c. To provide nurses with programming skills
d. To provide IT vendors with nursing practice information

Question 15.2: What is the difference between an Informatics Nurse (IN) and an Informatics Nurse Specialist (INS)?

a. The IN and the INS have identical preparation
b. The IN requires a BS and the INS requires a MS
c. The IN is one who has experience in Nursing Informatics and the INS is prepared at the graduate level with specialty courses in Nursing Informatics, a nursing specialty
d. The IN and INS both require only Nursing Informatics experience and certification by the ANA

Question 15.3: What is the purpose of Nursing Informatics Experts' code of Ethics?

a. To guide all nurses in practice of patient' rights
b. Used for administration of a healthcare facility
c. Needed in Electronic Health Record Systems
d. Used to guide Meaningful Use

Question 15.4: What does the Nursing informatics Scope and Standards of Practice include?

a. Provides a definition of Nursing Informatics True ___ False ___
b. Describes the new nursing specialty True ___ False ___
c. Includes Only four Standards of Nursing Practice True ___ False ___
d. Describes Non-Nursing Practices True ___ False ___
e. Includes the Nursing Process as Standards of Practice True ___ False ___

Question 15.5: Even though there has been many definitions of Nursing Informatics what are the overarching concepts of this specialty.

a. The core phenomena are the nurse, person, health, and environment
b. The meta-structures of nursing on data, information, knowledge, and wisdom

c. It focuses on a well-derived knowledge base, defined research program, organizational representation educational programs and credentialing mechanism

d. A specialty in nursing with a distinct body of knowledge

Question 15.6: Which scholars developed Models of Nursing Informatics?

a. Graves and Corcoran, Schwirian, Turley, and McGonigle and Mastrian

b. Schwirian, Graves and Corcoran, Saba and McCormick and Turley

c. Nelson, Schwirian, and McGonigle and Mastrian, Saba and McCormick

Question 15.7: What are the four levels of informatics competencies from novice to expert?

a. Novice Level, Expert Level, Computer Skills, and Informatics Knowledge

b. Novice Level, Informatics Knowledge, Expert Problem Solver, and Expert Level

c. Novice level, Advanced Beginner, Competent/ Proficient level, and Expert Level

d. Novice level, Acceptable Performance, Computer skills, and Informatics Knowledge

Question 15.8: What are some of the foundations of Nursing Informatics as a Nursing Specialty?

a. Nursing Science, Information Science, Computer Literacy and Computer Competencies

b. Computer Science, Information Science, Cognitive Science, and Communication Science

c. Communication Science, Change Theory, Computer Science and Computer Literacy

d. Computer Science, Nursing Science, Computer Literacy, and Computer Competencies.

Question 15.9: Question 15.9: When and who approved in the ANA Nursing Informatics as a new Nursing Specialty.

a. The ANA Council on Computer Applications in Nursing (CCAN) developed it in the Fall of 1991 and submitted to the Congress of Nursing Practice for approval and passage in 1992

b. The ANA Council on Computers Applications in Nursing (CCAN) developed it in the Fall of 1992 and submitted to the Congress on Nursing Practice for approval in 1993

Question 15.10: What are the Standards of Practice that an Informatics Nurse is expected to incorporate in their practice?

a. Assessment, Problem, Expected Outcome, Interventions, and Actual Outcomes

b. Care Component, Assessment, Diagnosis, Implementation, and Outcomes

c. Assessment, Diagnosis, Goal, Planning, Intervention Actions, and Actual Outcomes

d. Assessment, Diagnosis, Outcome Identification, Planning, Implementation, and Evaluation

ANSWERS AND EXPLANATIONS

Question 15.1: (a) To provide nurses with the data, information and support for information processing to make effective decisions. This decision making can encompass any and all of the following areas of nursing practice: Client care, research, education, and administration.

Question 15.2: (c) The IN is one who has experience in Nursing Informatics and the INS is prepared at the graduate level with specialty courses in Nursing Informatics, a nursing specialty. These two groups appear identical even though their preparation has been different; however, they have also been different based on the competencies of these two groups.

Question 15.3: (a) To guide all nurses in practice of patient' rights. In 2001 the ANA published the Code of Ethics for Nurses with Interpretive Statements. It was a complete revision of the previous version ethics provisions and interpretive statements that guide all nurses in practice, be it in the domains of direct patient care education, administration, or research. Nurses working in the informatics specialty are professionally bound to follow these provisions.

Question 15.4: What does the Nursing informatics Scope and Standards of Practice include?

a. Provides a Definition of Nursing Informatics. True ___ False ___

b. Describes the new nursing specialty. True ___ False ___

c. Includes Only four Standards of Nursing Practice. True ___ False ___

d. Describes Non-Nursing Practices. True ___ False ___

e. Includes the Nursing Process as Standards of Practice. True ___ False ___

Question 15.5: (b) The meta-structures of nursing on data, information, knowledge, and wisdom. The meta-structures of nursing on Data, Information, Knowledge, and Wisdom has evolved since the inception of Nursing Informatics. They emerged from the ANA's 16 Standards Professional Nursing which reflect specific knowledge, skills, abilities, and judgment expected by registered nurses. The standards include data, information, and knowledge management activities as core work for all nurses. Wisdom was added by Nelson to describe the impact on knowledge on nursing practice.

Question 15.6: (a) Graves and Corcoran, Schwirian, Turley, and McGonigle and Mastrian. Different scholars in nursing informatics have proposed different models. These models are examples of no one right model.

Question 15.7: (c) Novice Level, Advanced Beginner, Competent/ Proficient Level, and Expert Level. Benner's work built on the Dryfus model of skill acquisition described the evolution of a novice with beginning skills to an expert who has the capacity to intuitively understand a situation and immediately target the problem with minimal effort or problem solving.

Question 15.8: (b) Computer Science, Information Science, Cognitive Science, and Communication Science. The definitions of Nursing Informatics have evolved since 1985 when Kathryn Hannah proposed a definition of Nursing Informatics, the Graves and Corcoran presented a more complex definition 1989. Then in ANA developed a new NI definition by the Council on Computer Applications in Nursing (CCAN) and approved by the Congress of Nursing Practice in 1992 as well as the first scope of practice. Since then several versions have been proposed by numerous groups national and internationally with the most recent in 2014 when the ANA second edition of Nursing Informatics: Scope and Standards of Practice.

Question 15.9: (a) The ANA Council on Computer Applications in Nursing (CCAN) developed it in the Fall of 1991 and submitted to the Congress of Nursing Practice for approval and passage in 1992. The preparation of the approval of Nursing Informatics as a new nursing specialty was by the CCAN Executive Board—Werley, Saba, McCormick, and Zielstorff—and submitted to the Congress on Nursing Practice in the Fall 1991 and approved in 1992.

Question 15.10: (d) Assessment, Diagnosis, Outcome Identification, Planning, Implementation, and Evaluation.

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Nursing Informatics and Healthcare Policy

• OBJECTIVES

1. Discuss the significant impact of federal legislation from 2009 and 2010 on the use of health information technology.
2. Describe the creation of the office of the National Coordinator for Health Information Technology and summarize the major role it plays in the implementation of health information technology.
3. Discuss the implications of policy on nursing informatics as a specialty.
4. Identify the impact that national trends and events focused on information and information technology have on nursing informatics practice.
5. Outline the role of health IT in key emerging payment and clinical practice change initiatives; both in the government and in the private sector.

• KEY WORDS

Informatics
Health information technology
Public policy
Health policy
Electronic health record
HITECH

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What is the recent legislation that has stimulated the implementation of health information technology? How will the implementation influence clinical practice? Why is important for nurses to be informed of legislation?

For a WIIFM statement, say to the class, "Given the critical importance of nurses and health IT professionals to the future of healthcare transformation, it is important to understand the key components driving change in the industry: the primary influencers, organizations, programs and processes that have shaped or defined polices for the integration of health IT that will affect all segments of healthcare. Therefore, the purpose of this chapter is to identify and define the historic and present roles of such influencers, including sections on:

- Forces of Change in Today's National Healthcare System
- Mandate for Reform: ARRA and its HITECH Act Provision
- State and Regional Health IT Programs
- Health IT Federal Advisory Committees and Agencies
- Nursing Informatics and Healthcare Reform
- The Road Ahead"

As a nurse, it is important to understand recent legislation and the impact on the implementation of health information technology and quality.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook.
2. Encourage students to visit Internet Web sites relevant to the chapter content.

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OVERVIEW

Introduction and Background

1. On March 23, 2010, President Barack Obama signed into law the landmark Patient Protection and Affordable Care Act (ACA)
2. As upheld on June 28, 2012 in an historic and landmark decision by the US Supreme Court
   - a. ACA was a hard-fought federal statute
   - b. That represents the sweeping healthcare-reform agenda
   - c. Envisioned by the Democratic 111th Congress and the Obama Administration
3. Despite legal challenges that sought and to reverse "Obamacare"
   - a. The law was and is dedicated to replacing a broken system with one
   - b. That ensures all Americans access to healthcare
   - c. That is both affordable and driven by quality standards
4. It includes broad provisions for the improvement of healthcare delivery that
   - a. Unless declared unconstitutional
   - b. Will run through the end of the present decade
5. For the Obama administration and the nation
   - a. ACA turned a spotlight on the ever-increasing recognition that advanced health information technology (health IT) is
   - b. And will be essential to support the massive amounts of electronic information exchange foundational to industry reform
6. In fact, the universal agreement that meaningful healthcare reform
   - (1) Cannot be separated from the national—and arguably global—integration of health IT
   - (2) Based on accepted, standardized, and interoperable methods of data exchange
   - (3) Provided the linchpin for other critically important legislation that created a glide path for ACA
7. It was such consensus that resulted in the broad support and passage
   - a. Into law of the American Recovery and Reinvestment Act (ARRA) of 2009
   - b. And its key Health Information Technology Act (HITECH) provision in the early weeks of Mr. Obama's presidency
8. Backed with an allocation of around $22 billion
   - a. This legislation authorized the Centers for Medicare and Medicaid Services (CMS)
   - b. To provide reimbursement incentives for eligible professionals and hospitals
   - c. That takes steps to become "meaningful users" of certified Electronic Health Records (EHR) technology to improve care quality and better manage care costs
9. At the core of the new reform initiatives
   - a. The incentivized adoption of EHRs by eligible hospitals and providers
   - b. Across the nation improves care quality and better manages care costs
10. It also helps to meet clinical and business needs
    - a. Since capturing, storing, and displaying clinical information from EHRs
    - b. When and where it is needed
    - c. Improves individual patient care while providing aggregated, cross-patient data analysis
11. EHRs manage healthcare data and information in ways that are
    - a. Patient-centered
    - b. Secure
    - c. Information-rich
12. Improved information access and availability across the continuum of care
    - a. Increasingly enables both the provider and the patient to better manage each patient's health
    - b. By using capabilities provided
    - c. Through enhanced clinical decision support and customized education materials
13. In this massive transformation
    - a. From disconnected, inefficient, paper-based "islands" of care delivery
    - b. To a nationwide, interconnected, and interoperable system driven by EHRs and advancing health IT innovation
    - c. The importance of nurses and nursing informatics (NI) is difficult to overstate
14. For decades, nurses have proactively contributed resources to the
    - a. Development
    - b. Use
    - c. Evaluation of information systems
15. Today, they constitute the largest single group of healthcare professionals
    - a. And include experts who serve on national committees
    - b. And participate in interoperability initiatives focused on policy, standards and terminology development, standards harmonization, and EHR adoption
16. In their front-line roles nurses
    - a. Continue to have a profound impact on the quality and cost of healthcare
    - b. And are emerging as leaders in the effective use of HIT to improve the safety, quality, and efficiency of healthcare services
17. It is informatics nurses who are key contributors to
    - a. A working knowledge about how evidence-based practices designed in information systems
    - b. Can support and enhance clinical processes and decision making to improve patient safety and outcomes

18. Also, as the "glue" of acute care delivery settings who are responsible for care coordination and promotion of wellness
    a. Nurses are often the patient's primary contact
    b. And the last defensive line in care delivery
    c. Where medical errors or other unintended actions can be caught and corrected
19. In addition, as drivers in organizational planning and process reengineering to improve the healthcare delivery system
    a. Informatics nurses are increasingly sought out by nurses and nurse managers
    b. For leadership as their profession works
    c. To bring IT applications into the mainstream healthcare environment
20. The importance of nursing in healthcare reform was confirmed in the 2010 landmark report
    a. The Future of Nursing: Leading Change, Advancing Health from the Institute of Medicine (IOM) and the Robert Wood Johnson Foundation (RWJF)
    b. Based on the report's recommendations, the RWJF began the Initiative on the Future of Nursing
    c. Through the Initiative, RWJF continues to support the research agenda set forth by the report and implement the recommendations in the areas of nurse training, education, professional leadership, and workforce policy
21. It will be increasingly essential to the success of today's healthcare-reform movement that nurses are involved in every aspect of
    a. Selecting
    b. Designing
    c. Testing
    d. Implementing
    e. And developing health information systems
22. Further, the growing adoption of EHRs
    a. Must incorporate nursing's unique body of knowledge
    b. With the nursing process at its core
23. Major forces of reform are fueling sharply increased demand for a larger health IT workforce across the US healthcare landscape
24. Wrote The New York Times' Reed Abelson in late 2011, "... healthcare in America has changed in ways that will not be easily undone. Provisions already put in place, like tougher oversight of health insurers...are already well cemented and popular"
25. In a similar article, *USA Today* concurred, reporting that health IT job growth is being driven by the general restructuring of the healthcare industry
26. This includes not only ACA, but also 2009 federal stimulus funding, new government regulations, and increasing use of health IT across the industry
27. Supporting this viewpoint
    a. The Bureau of Labor Statistics has projected that employment growth in the health IT area will increase overall by 20 percent through 2020
    b. With some segments like network and computer systems administrators expanding by 28 percent
28. Information security concerns are
    a. Also increasing for many healthcare organizations
    b. As managers realize that current security measures
    c. Are insufficient to protect the privacy of growing volumes of patients' protected healthcare information (PHI)
29. As a direct result
    a. More new opportunities for computer and information management professionals
    b. Will be driven by organizations
    c. Upgrading their health IT systems and switching to newer, faster, and more mobile networks
30. As a major factor in such dynamics
    a. The growing commitment by health systems and physician practices
    b. To the implementation and demonstrated meaningful use of certified EHR systems
    c. Will also continue to create new opportunities for health IT professionals
31. Three years into the program to drive the adoption and meaningful use of certified EHRs
    a. Sixty-three percent of all eligible providers and 86 percent of all eligible hospitals
    b. Have received an EHR incentive payment from either Medicare or Medicaid, as of November 2013
32. Three out of every five Medicare eligible physicians and professionals are meaningful users of EHRs
33. As of November 2013
    a. Participation in meaningful-use has accounted for well more than $17.8 billion in Medicare and Medicaid incentive payments
    b. To nearly 310,000 hospitals and physicians
34. More than half of all doctors and all other eligible providers have received incentive payments for meaningful use
    a. And by May 2013, Health and Human Services (HHS) had exceeded its goal of
    b. Fifty percent of doctors
    c. And 80 of eligible hospitals using EHRs by the end of 2013
35. All in all, some 50,000 qualified health IT workers will be needed
    a. To meet the demands of hospitals and physicians
    b. As they move to adopt EHRs and connect to statewide health information exchanges (HIEs)
36. The Bureau of Labor Statistics, Department of Education, and independent studies estimate a workforce shortfall over the next five years
37. One recent study, conducted by PwC's Health Research Institute and shows that the growing shortage appears greater than previously reported
    a. According to the report, nearly 80 percent of global healthcare CEOs surveyed expect to increase technology investments in 2013
    b. More than half (51%) fear their staff cannot keep up with the pace of technological change
    c. Seventy-seven percent say they are revisiting their hiring and promotion strategies to address the gaping holes in health IT

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Chapter Overview

Teaching Tip
Review the following if not provided when gaining attention and establishing common ground

Given the critical importance of nurses and health IT professionals to the future of healthcare transformation, it is important to understand the key components driving change in the industry: the primary influencers, organizations, programs and processes that have shaped or defined polices for the integration of health IT that will affect all segments of healthcare. Therefore, the purpose of this chapter is to identify and define the historic and present roles of such influencers, including sections on:

- *Forces of Change in Today's National Healthcare System*
- *Mandate for Reform: ARRA and its HITECH Act Provision*
- *State and Regional Health IT Programs*
- *Health IT Federal Advisory Committees and Agencies*
- *Nursing Informatics and Healthcare Reform*
- *The Road Ahead*

Forces of Change in Today's National Healthcare System

Overview

a. The long journey to the passage of ACA, ARRA, and HITECH goes back several decades

b. In 1991, the IOM concluded that
  - **(1)** Computerization could help to improve patient records and information management
  - **(2)** Leading to higher quality of care in its landmark report, *The Computer-Based Patient Record: An Essential Technology for Healthcare*

c. That was followed nearly a decade later with other groundbreaking reports calling for the use of health IT to improve the efficiency, safety, and quality of the US healthcare system
  - **(1)** *To Err Is Human in 1999*
  - **(2)** *Crossing the Quality Chasm in* 2001

d. These reports were a call to action
  - **(1)** For a paradigm shift from reliance on paper and verbal communication for managing patient care
  - **(2)** To a new era where healthcare professionals are supported in their clinical decision-making by technology while providing patient care

e. IOM followed up on these reports in 2012 with
  - **(1)** *Best Care at Lower Cost: The Path to Continuously Learning Healthcare in America*
  - **(2)** Which urged systemic transformation to reduce inefficiencies in the health system
  - **(3)** The report said the complexity and inefficiencies in American's healthcare system are a threat
  - **(4)** Not only to quality healthcare, but to the nation's economic stability and global competitiveness

f. Further, the early report on the Computer-Based Patient Record
  - **(1)** Called for an urgent across-the-board commitment to continuous improvement
  - **(2)** Incremental upgrades by individual hospitals and other providers would no longer suffice
  - **(3)** One of the main points of the report was that better data management, including EHRs and mobile technologies would be a key method in upgrading healthcare while reducing inefficiency and lowering costs

g. In looking back at other significant forces of change
  - **(1)** One of the earliest and most influential was PITAC
  - **(2)** The President's Information Technology Advisory Committee

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

1. The President's Information Technology Advisory Committee

a. In 1997, an Executive Order of the President
  - **(1)** Established the visionary, 24-member President's Information Technology Advisory Committee (PITAC)
  - **(2)** Which was comprised of both corporate and academic leaders from across the United States

b. Since its inception, the committee has
  - **(1)** Provided the President, Congress, and those federal agencies involved in networking and information technology (IT) research and development
  - **(2)** With expert, independent advice on maintaining American preeminence in advanced information technologies

c. In 1999, as part of its seminal work to define how IT could drive progress in the 21st century
  - **(1)** PITAC established a panel to provide guidance
  - **(2)** On how IT could be leveraged to transform healthcare and increase access to care for all citizens

d. Driving the panel's work was
  - **(1)** The firm conviction that the Federal government's role in leading the way to healthcare reform through technology was
  - **(2)** Both critical and, at the time, sorely lacking

e. In a report entitled, *Transforming Healthcare through Information Technology*
  - **(1)** PITAC found that "at present, the US lacks
  - **(2)** A broadly disseminated and accepted national vision for information technology in healthcare"

  - **f.** To rectify the situation, the panel strongly recommended that HHS
    - **(1)** Define a clear vision of how IT could improve the US healthcare system
    - **(2)** Follow up with resources sufficient to accomplish its objectives
    - **(3)** And appoint a senior IT person to provide strategic leadership

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. President's Council of Advisors **for Science and Technology**
  - **a.** After allowing PITAC's charter to expire, President George W. Bush announced that the President's Council of Advisors for Science and Technology (PCAST) would oversee the Networking and Information Technology Research and Development (NITRD) Program
  - **b.** As such, PCAST membership would increase and assume PITAC's responsibilities
  - **c.** The National Coordinating Office for IT called it an elevation of the role of external information technology advice in the White House," and assigned a broader charter than the former committee's narrow focus on IT
  - **d.** Over next few years, PCAST studied and produced reports on issues ranging from energy and technology to nanotechnology to personalized medicine
  - **e.** One of the most highly anticipated reports was the 2010 report, *Realizing the Full Potential of Health Information Technology to Improve Healthcare for Americans: The Path Forward*
  - **f.** The report pointed out the necessity of using health technology to increase access to patient information, streamline patient diagnoses and care, improve monitoring of public health trends, and enhance the ability to conduct clinical trials
  - **g.** With the use of technology, these healthcare goals could be accomplished while lowering costs and giving patients "unprecedented" control over who may access their records
  - **h.** In a letter to the President accompanying the report, PCAST cochairs John P. Holdren and Eric Lander said it "is crucial that the Federal Government facilitate the nationwide adoption of a universal exchange language for healthcare information and a digital infrastructure for locating patient records while strictly ensuring patient privacy"
  - **i.** The cochairs urged the Office of the National Coordinator for Health Information Technology (ONC) and CMS to develop guidelines for the transition from traditional EHRs to the health information exchanges

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. President Bush's Executive Order and the Birth of ONC
  - **a.** On January 20, 2004, President George W. Bush in his State of the Union address called for "... an Electronic Health Record for every American by the year 2014 ... By computerizing health records, we can avoid dangerous medical mistakes, reduce costs, and improve care"
  - **b.** He went on to issue an executive order that same year: "Incentives for the Use of Health Information Technology and Establishing the Position of the National Health Information Technology Coordinator," which has had an impact on every healthcare entity, provider, and informatics professional in the United States
  - **c.** Components of the order were to
    - **(1)** Establish a national health information technology coordinator position
    - **(2)** Develop a nationwide interoperable health IT infrastructure
    - **(3)** Develop, maintain, and direct implementation of a strategic plan to guide implementation of interoperable health IT in both public and private sectors
    - **(4)** Dr. David Brailer was appointed as the first national coordinator by Tommy Thompson, then Secretary of HHS
    - **(5)** ONC remains today the principal federal entity charged with
      - **(1)** Coordination of nationwide efforts to implement
      - **(2)** And use the most advanced health IT and the electronic exchange of health information
    - **(6)** ONC is a key player in the execution of ARRA and its HITECH Act provision
    - **(7)** ARRA authorized the creation of two committees
      - **(1)** The Health IT Policy Committee
      - **(2)** The Health IT Standards Committee
      - **(3)** That make recommendations to the ONC
    - **(8)** The Policy Committee
      - **(1)** Works on a policy framework for a nationwide health information infrastructure
      - **(2)** Including the exchange of patient medical information
    - **(9)** The Standards Committee recommends specifications and certification criteria for the electronic exchange and use of health information
    - **(10)** Dr. Farzad Mostashari
      - **(1)** Who was appointed by HHS Secretary Kathleen Sebelius on May 2011
      - **(2)** Succeeded Dr. David Blumenthal, as the National Coordinator. Mostashari stepped down in October 2013
    - **(11)** The new National Coordinator
      - **(1)** Dr. Karen DeSalvo
      - **(2)** Was appointed by Secretary Sebelius in January 2014

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. **Health IT Training Programs: An Essential Element of Reform**
   - **a.** Today's urgent need for health IT experts is challenged by
     - **(1)** a shortage of the very professionals
     - **(2)** who are best positioned to carry transformation forward
   - **b.** With consensus around the essential requirement for advanced health IT and the mounting pressures of shortages in nursing, health IT experts, and other medical professions, the United States
   - **c.** Government through HHS has enlisted the talent and resources of some of the nation's leading
     - **(1)** Universities
     - **(2)** Community colleges
     - **(3)** And major research centers to advance the widespread adoption and meaningful use of health IT
   - **d.** These schools offer a wide variety of training programs that are helping to build the depth and breadth of the health IT workforce as a critical component in the transformation of American healthcare delivery
   - **e.** Both on-campus and online programs in health IT are available at the
     - **(1)** Certificate
     - **(2)** Associate
     - **(3)** Bachelors
     - **(4)** And master's degree levels
   - **f.** Certificate programs typically
     - **(1)** Consist of 15 to 30 credit hours
     - **(2)** And are often designed for working professionals
   - **g.** The American Medical Informatics Association (AMIA) created a revolutionary "10 X 10" Program in 2005
     - **(1)** With the goal of training 10,000 healthcare professionals in applied health informatics within 10 years
     - **(2)** And became a model for certificate-based programs
   - **h.** Through an ARRA-funded cooperative agreement program
     - **(1)** Federal awards and grants totaling some $118 million to 16 universities and 82 community colleges
     - **(2)** Provided incentives for health IT education to speed the growth of a new pool of health IT professionals
   - **i.** These programs supported the training and development of more than 20,000 new health IT professionals
   - **j.** The Health IT Workforce Development workgroup of the Health IT Policy Committee was formed in July of 2012
   - **k.** The workgroup recommended that
     - **(1)** ONC-funded programs and their core competencies be summarized and publicized
     - **(2)** Along with the many resources available for education and best practices
   - **l.** The Workgroup also recommended new programs and funding to address emerging needs such as
     - **(1)** Team-based care
     - **(2)** Population health
     - **(3)** Patient engagement
     - **(4)** And studies to assess the impact of health IT on the incumbent workforce
   - **m.** Last, health IT needs to be represented in the
     - **(1)** Standard Occupational Classification (SOC)
     - **(2)** Committee is seeking input to have it included in the next addition, due out in 2018

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. **The Health Insurance Portability and Accountability Act: Privacy and Security**
   - **a. Overview**
     - **(1)** The Health Insurance Portability and Accountability Act (HIPAA), which passed in 1996
     - **(2)** Required HHS to develop regulations protecting the privacy and security of electronic health information
     - **(3)** As well as facilitate its efficient transmission
     - **(4)** HIPAA's goals are to allow the flow of health information needed to provide and promote high quality healthcare While protecting the public's health and well-being
     - **(5)** Prior to HIPAA, no generally accepted set of standards or requirements for protecting health information existed in the healthcare industry
     - **(6)** At the same time, new technologies were evolving to move the healthcare industry away from paper processes and to increase the reliance on electronic information systems
     - **(7)** To conduct a host of administrative and clinically based functions, such as providing health information, paying claims, and answering eligibility questions
     - **(8)** To comply with the requirements of the Act, HHS published what are commonly known as the HIPAA Privacy Rule and the HIPAA Security Rule
     - **(9)** The rules apply to all health plans, healthcare clearinghouses, and to any healthcare provider that transmits health information in electronic form

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

   - **b. The HIPAA Privacy Rule**
     - **(1)** The HIPAA Privacy Rule, which took effect on April 14, 2003, established national standards for the protection of individually identifiable health information

(2) The rule regulates the use and disclosure of an individual's health information, referred to as Protected Health Information (PHI)

(3) Sets forth standards for individuals' privacy rights to understand and control how their health information is used

(4) The rule applies to those organizations identified as "covered entities," which include healthcare clearinghouses, employer-sponsored health plans, health insurers, and other medical service providers that engage in the transfer of PHI

(5) PHI is defined broadly and includes any part of an individual's medical record or payment history

(6) The final HIPAA/HITECH Act Privacy, Security, Enforcement, Breach Notification Rules were published in the *Federal Register* on January 25, 2013

(7) The final omnibus rule greatly enhances a patient's privacy protections and provides individuals new rights to their health information

(8) While the original HIPAA Privacy and Security Rules focused on healthcare providers, health plans and other entities that process health insurance claims

(9) The changes expanded many of the privacy requirements to business associates of these entities that receive protected health information, such as contractors and subcontractors

(10) The rule increased penalties for noncompliance based on the level of negligence with a maximum penalty of $1.5 million per violation

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

c. The HIPAA Security Rule

(1) The HIPAA Security Rule took effect on April 21, 2003

(2) With a compliance date of April 21, 2005 for most covered entities

(3) The Security Rule complements the Privacy Rule;

(4) While the Privacy Rule pertains to all PHI, including paper and electronic records

(5) The Security Rule deals specifically with Electronic Protected Health Information (ePHI)

(6) A major goal of the Security Rule is to protect the privacy of individuals' PHI while allowing covered entities to adopt new technologies to improve the quality and the efficiency of patient care

(7) The Security Rule is designed to be flexible and scalable so that a covered entity can implement policies, procedures, and technologies that are appropriate for the entity's particular size, organizational structure, and risks to consumers' electronic ePHI

(8) In the years following its passage and implementation, HIPAA regulations have had a significant impact on health informatics

(9) For example, under HIPAA, patients must be permitted to review and amend their medical records

(10) Healthcare providers have expressed concern that patients who choose to access their records could experience increased anxiety

(11) Other studies have determined that counter-benefits already include enhanced doctor-patient communications and only minimal risks in increasing patients' access to their records

(12) The passage of ARRA expanded HIPAA's mandate to impose new privacy and security requirements

(13) One of the greatest changes to HIPAA presently affecting the healthcare community and health IT professionals are the modifications published on January 16, 2009 in the HIPAA Electronic Transaction Standards Final Rule

(14) As originally framed, the old version of the American National Standards Institute (ANSI) X12 Standards for HIPAA transactions were to be replaced by Version 5010, which regulates the transmission of certain healthcare transactions among hospitals, physician practices, health plans, and claims clearinghouses

(15) In addition, the old version of the National Council for Prescription Drug Program (NCPDP) standard for pharmacy and supplier transactions was to be replaced by Version D.0

(16) As the first major change since HIPAA's implementation, the introductions of these new standards are meant to enhance business functionality, clarify ambiguities, and better define situational and required data elements

(17) The new rules apply to all physicians, providers, and suppliers who bill Medicare carriers, fiscal intermediaries, Medicare administrative contractors (MACs), and durable medical equipment MACs for services provided to Medicare beneficiaries

(18) When first announced, the switch to the 5010 standards was supposed to be in place on January 1, 2012

(19) In November 2011, however, CMS decided that, although it would not change the actual deadline for complying with the standards, it would not initiate enforcement action until March 31

(20) Soon thereafter, in continued reconsideration of what it called "a number of outstanding issues and challenges impeding full implementation," CMS pushed the enforcement date back to July 1, 2012

(21) The conversion to the HIPAA 5010 standards is seen as key to the larger switch from the ICD-9 clinical coding system to the vastly more detailed ICD-10 system — ICD-10 conversion is set for October 1, 2014

(22) More recently, the final rule to HIPAA, as mentioned in the previous section, enhances the HITECH Breach Notification requirements by clarifying when breaches of unsecured health information must be reported to HHS

(23) The changes also strengthen the government's ability to enforce the law

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

6. **EHR Certification and Testing**
   - **a.** With the passage of ARRA and HITECH, ONC has become the driving force behind
     - **(1)** The definition of meaningful use of EHRs
     - **(2)** And the certification of EHR systems
   - **b.** This new reality changed the operating environment for the Certification Commission for Healthcare Information Technology (CCHIT), which until 2009 had been the sole organization to certify EHR systems
   - **c.** CCHIT was founded in 2004 with support from three industry associations in healthcare information management and technology
     - **(1)** The American Health Information Management Association (AHIMA)
     - **(2)** The Healthcare Information and Management Systems Society (HIMSS)
     - **(3)** And the National Alliance for Health Information Technology (NAHIT)
   - **d.** In September 2005, HHS awarded CCHIT a contract to develop
     - **(1)** The certification criteria
     - **(2)** The inspection process for EHRs
     - **(3)** And the networks through which they interoperate
   - **e.** The certification criteria were developed through a voluntary, consensus-based process engaging diverse stakeholders
   - **f.** Many health IT professionals were involved in this process
     - **(1)** Helping to define the certification criteria for the hospital and ambulatory environments
     - **(2)** As well as outlining the testing processes used by CCHIT
   - **g.** However, in the months following the 2009 passage of ARRA, questions surfaced about CCHIT's unique role going forward
   - **h.** On March 2, 2010, ONC confirmed the merits of this debate when it issued a new Notice of Proposed Rulemaking, which proposed the establishment of two certification programs for the purposes of testing and certifying EHRs—one temporary and one permanent
   - **i.** These new programs were not limited to CCHIT
   - **j.** On June 24, 2010, ONC published the Final Rule on the Temporary Certification Program for EHRs
   - **k.** Under the temporary program
     - **(1)** ONC authorized approved organizations, called ONC-Authorized Testing and Certification Bodies (ONC-ATCBs)
     - **(2)** To both test and certify EHRs and EHR Modules
     - **(3)** Thereby assuring the availability of Certified EHR Technology prior to the beginning of the reporting period defined under ARRA
   - **l.** After the first year
     - **(1)** The permanent certification program replaced the temporary program
     - **(2)** And now separates the responsibilities for performing testing and certification
     - **(3)** Now called Authorized Test Labs (ATLs) and Authorized Certification Bodies (ACBs)
   - **m.** In addition to EHR and EHR module certification, the permanent program includes
     - **(1)** The certification of other types of health IT, such as personal health records (PHRs)
     - **(2)** And health information exchange (HIE) networks
   - **n.** With the launch of the ONC Health IT Certification Program, the Temporary Certification Program sunset on October 4, 2012

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

7. **Standards and the Nationwide Health Information Network**
   - **a.** In late 2005, the US Department of Health and Human Services commissioned the Healthcare Information Technology Standards Panel (HITSP) to assist in developing a Nationwide Health Information Network (NwHIN)
   - **b.** This would create a nationwide, interoperable, private and secure exchange of health information between EHRs
   - **c.** NwHIN is intended to provide a set of standards that regulate the connections among providers, consumers, and others involved in supporting health and healthcare
   - **d.** The purpose of these standards
     - **(1)** Is to enable normalized health information to follow the consumer
     - **(2)** It is intended to make health records, laboratory results, medication information, and related medical data readily available and accessible to providers, pharmacists, and even consumers over the Internet
     - **(3)** Thereby helping to achieve the goals of the HITECH Act
   - **e.** NwHIN is dedicated to ensuring that consumers' health information remains secure and confidential in the electronic environment
   - **f.** In January 2011, NwHIN began to be referenced as the "Nation*wide* Health Information Network"—or NwHIN
   - **g.** The change emphasizes that NwHIN is
     - **(1)** A set of standards, services, and policies
     - **(2)** That enables secure health information exchange over the Internet
   - **h.** These standards are today being used by three Federal initiatives
     - **(1)** The Direct Project
     - **(2)** NwHIN Exchange
     - **(3)** And the CONNECT software project

- **i.** It also served notice that NwHIN continues to evolve with the government acting as a facilitator—not as an infrastructure builder
- **j.** Its development depends
    - **(1)** On an environment of collaboration, transparency, and buy-in from the bottom up
    - **(2)** Small as well as large physician groups and health systems who are working to share patient records with other care delivery entities across the continuum of care
- **k.** In October, 2102, ONC launched the NwHIN Exchange, which includes federal and nonfederal agencies that share patient information for care
- **l.** Currently the exchange encompasses more than twenty federal and nonfederal agencies
- **m.** They also announced that the NwHIN Exchange had officially been converted into eHealth Exchange
    - **(1)** A public-private partnership to increase health information exchange (HIE) innovation in the private sector
    - **(2)** It was developed under the auspices of the ONC and is managed by a nonprofit industry coalition called HealtheWay

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

8. Interoperability

a. Overview

- **(1)** Interoperability is the ability of health information systems to work together within and across organizational boundaries to advance the effective delivery of healthcare for individuals and communities by sharing data between EHRs
- **(2)** It is not simply the exchange of data between two organizations
- **(3)** Rather the ability of the two organizations to exchange and consume data to and from each other's EHRs
- **(4)** For interoperability to occur, standards are required for data transport, content exchange, and vocabulary management
- **(5)** This is why standards development is so important—it enables the interoperability needed for regional and national health data exchange and is essential to the development of the NwHIN
- **(6)** Debate exists as to how interoperability should develop relative to EHR adoption in terms of timing
- **(7)** Many industry leaders believe that interoperability should precede EHR use
- **(8)** They are convinced that the ability to share information should be designed into EHRs and that the infrastructure and industry capacity for securely networking this information should exist up front
- **(9)** On the other hand, others argue that interoperability will follow widespread EHR adoption
- **(10)** This side of the debate believes that once health information becomes electronic and everyone is using EHRs, interoperability will naturally follow, since it will be easier and cheaper than manual data sharing

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

b. HIE Governance

- **(1)** In May 2012, ONC released to the public a request for information (RFI) on the governance of the Nationwide Health Information Network
- **(2)** Believing this would constitute a critical step toward enabling trusted and interoperable electronic health information exchange nationwide
- **(3)** ONC saw a common set of "rules of the road" for privacy, security, business and technical requirements as a means of laying the necessary foundation to enable our nation's electronic health information exchange capacity to grow
- **(4)** It could also help achieve the Bush and Obama Administration's vision for an electronically connected health system for the 21st century that delivers efficient and quality healthcare for all Americans
- **(5)** The RFI asked for public feedback on how a governance mechanism would best provide confidence to patients that their health information is being shared appropriately and securely; reassure providers they are dealing with trusted entities when sending or receiving patient information; promote an open and competitive market for electronic health information exchange; and enable innovation to thrive
- **(6)** The response to the RFI was a desire not to regulate, but to let the market mature and follow a non-regulatory approach
- **(7)** As such, the Governance Framework for Trusted Electronic Health Information Exchange (the Governance Framework) was released in May 2013 and is intended to serve as guiding principles on HIE governance
- **(8)** It is meant to provide a common conceptual foundation applicable to all types of governance models and express the principles ONC believes are most important for HIE governance
- **(9)** The Governance Framework does not prescribe specific solutions, but lays out milestones and outcomes that ONC expects for and from HIE governance entities as they enable electronic HIE
- **(10)** The exchange standards were specified by ONC to correspond with the CMS meaningful use measures to promote the use of EHRs to improve healthcare by providing complete and accurate patient information and increased access to information as well as to encourage patients' involvement in their own healthcare

(11) Stage 1 of Meaningful provided incentives to help providers implement EHRs

(12) Now at Stage 2, in effect at the end of 2013, measures focus on health information exchange to improve the flow of information between providers and with patients

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

c. Integrating the Healthcare Enterprise

(1) Integrating the Healthcare Enterprise (IHE) is a global initiative

(2) Now in its twelfth year, to create the framework for passing vital health information seamlessly from application to application, system to system, and setting to setting across multiple healthcare enterprises

(3) IHE brings together health IT stakeholders to demonstrate the implementation of standards for communicating patient information efficiently throughout and among healthcare enterprises by developing a framework of interoperability

(4) Has a proven process of collaboration, demonstration, and real world implementation of interoperable solutions

(5) IHE is in a unique position to significantly accelerate the process for defining, testing, and implementing standards-based interoperability among EHR systems

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

9. Nonprofit Organizations Driving Reform

10. Overview

(1) Among the many nonprofit organizations today advancing health IT and nursing informatics,

(2) Few have had such positive impact on the industry than the American Medical Informatics Association (AMIA) and the Healthcare Information and Management Systems Society (HIMSS)

(3) Both organizations have significant numbers of health IT professionals who are expert informaticists as well as committees, task forces, and working groups for the health IT community

11. AMIA

(1) AMIA is dedicated to promoting the effective organization, analysis, management, and use of information in healthcare to support patient care, public health, teaching, research, administration, and related policy

(2) For more than 30 years, the 4,000 some members of AMIA and its honorific college, the American College of Medical Informatics (ACMI), have sponsored meetings, education, policy, and research programs

(3) The federal government frequently calls upon AMIA as a source of informed, unbiased opinions on policy issues relating to the national health information infrastructure, uses and protection of personal health information, and public health considerations, among others

Teaching Tip
Provide the following example, ONC, for example, requested input from AMIA on the proposed Health IT Patient Safety Action and Surveillance Plan. After review, the AMIA submitted its comments to ONC, which was able to incorporate some of their recommendations in the final plan.

(4) With an overall mission of advancing the informatics profession relating to health and disease

(5) AMIA champions the use of health information and communications technology in clinical care and research, personal health management, public health/population, and transactional science with the ultimate objective of improving health

(6) The association is also dedicated to expanding the size and strengthening the competency of the US health informatics workforce

(7) And supporting the continued development of the health informatics profession

12. HIMSS

(1) HIMSS was founded in 1961

(2) HIMSS is a comprehensive healthcare-stakeholder membership organization

(3) Exclusively focused on providing leadership for the optimal use of IT and management systems for the betterment of healthcare

(4) A global organization with offices in Chicago, Washington DC, Brussels, and Singapore

(5) HIMSS represents more than 23,000 members, 73 percent of whom work in patient care delivery settings

(6) HIMSS also includes corporate members and not-for-profit organizations that share its mission to transform healthcare through the effective use of IT and management systems

(7) The society was founded on the premise that an organized exchange of experience among members could promote a better understanding of the principles underlying healthcare systems and improve the skills of those who direct health IT programs and the practitioners who analyze, design, or evaluate health IT systems

(8) In today's environment of rapid reform and transformation, HIMSS frames and leads healthcare public policy and industry practices through its educational, professional development, and advocacy initiatives designed to promote information and management systems' contributions to ensuring quality patient care

(9) HIMSS, like AMIA, often provides input on Health IT issues and government programs

(10) It also recently provided comments to ONC on the Health IT Patient Safety Action and Surveillance Plan

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Mandate for Reform: ARRA and its HITECH Act Provision

1. **Overview**
    a. ARRA and its important HITECH Act provision were passed into law on February 17, 2009
    b. Commonly referred to as “The Stimulus Bill” or “The Recovery Act,” the landmark legislation allocated $787 billion to stimulate the economy, including $147 billion to rescue and reform the nation’s seriously ailing healthcare industry
    c. Of these funds, about $22 billion in financial incentives were earmarked for the relatively short period of five years to drive reform through the use of advanced health IT and the adoption of EHRs
    d. As noted in this chapter’s introduction, the incentives were intended to help healthcare providers purchase and implement health IT and EHR systems, and the HITECH Act also stipulated that clear penalties would be imposed beyond 2015 for both hospitals and physician providers who failed to adopt use of EHRs in a meaningful way
    e. This section describes some of the key components of ARRA and HITECH

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. **Incentives for Meaningful Use of EHRs**
    a. The majority of the HITECH funding will be used to reward hospitals and eligible providers for “meaningful use” of certified EHRs by “meaningful users” with increased Medicare and Medicaid payments
    b. The law specifies that eligible healthcare professionals and hospitals can qualify for both programs when they adopt certified EHR technology and use it in a meaningful way
    c. Exactly what HITECH, as administered by ONC and CMS, means by the term “meaningful use” is a dynamic, evolutionary process that will involve three stages
        (1) **Stage 1:** Beginning in 2011 as the incentive program’s starting point for all providers; “meaningful use” here consists of transferring data to EHRs and beginning to share information, including electronic copies and visit summaries for patients
        (2) **Stage 2:** To be implemented in 2014 “meaningful use” includes significant new exchange functionality such as online patient access to their health information and electronic health information exchange during transitions between providers
        (3) **Stage 3:** Expected to begin in 2017, “meaningful use” in this stage is projected to include measures that demonstrate improvement in the quality of healthcare
3. **Milestones in Meaningful Use Program**
    a. Milestone dates and their significance to the Meaningful Use Program in the United State are summarized in the following paragraphs
    b. **December 31, 2009:** CMS, with input from ONC and the HIT Policy and Standards Committees, published a Stage 1 Proposed Rule on Meaningful Use of EHRs and began a 60-day public comment period
    c. **July 28, 2010:** After reviewing more than 2,000 comments, HHS issued the Stage 1 Final Rule, with final criteria for meeting “Meaningful Use” divided into five initiatives
        (1) Improve quality, safety, efficiency, and reduce health disparities
        (2) Engage patients and families
        (3) Improve care coordination
        (4) Improve population and public health
        (5) Ensure adequate privacy and security protections for personal health information
    d. Specific objectives were written to demonstrate that EHR use would have a “meaningful” impact on one of the five initiatives
    e. Under the final rule, participating providers are today working to meet 14 “core” (required) objectives for hospitals and 15 for providers
    f. For both hospitals and providers, the rule sets out 10 other objectives in a “menu set” from which they must choose and comply with 5
    g. If the objectives are met during the specified year and the hospital or provider submits the appropriate measurements, then the hospitals or providers will receive the incentive payment
    h. The hospital incentive amount is based on the Medicare and Medicaid patient volumes; the provider incentives are fixed per provider
    i. The incentives are paid over five years, and the hospital or provider must submit measurement results annually during each of the years to continue to qualify
    j. **November 30, 2011:** In the launch of an initiative called, “We Can’t Wait,” HHS and the Obama Administration acknowledged the challenges of meeting Stage 2 timeline requirements. Under the original requirements, eligible doctors and hospitals that begin participating in the Medicare EHR Incentive Programs in 2011 would have to meet new standards for the program in 2013. But if they chose not participate in the program until 2012, they could wait to meet the same standards until 2014 and still be eligible for identical incentive payments. Therefore, to encourage faster adoption, the HHS’ announcement cleared the way for doctors and hospitals to adopt health IT in 2011without formally meeting the new standards until 2014. These policy changes were also accompanied by greater outreach efforts to provide more information to doctors and hospitals about best practices. They also sought to help vendors whose products were straining to keep up with the changing requirements for their technologies, which allow healthcare providers to meaningfully use EHRs

- **k. February 23-24, 2012:** CMS and HHS announced Stage 2 meaningful-use steps for providers using EHR technology and receiving Stage 1 incentives payments from Medicare and Medicaid. The proposed rule, which was submitted to the public for a comment period that ended on May 7, 2012, was intended to define more than the Stage 2 criteria that eligible providers must meet to qualify for incentive payments. In addition, the finalized Stage 2 rules define the "payment adjustments" or penalties that, beginning in 2015, providers will face if they fail to demonstrate the meaningful use of certified EHR technology and fail to meet other program participation requirements
- **l. August 23, 2012:** The federal government released the final rules for Stage 2 of meaningful use with assurance that the public's voice was heard. The rules, which focus on health information exchange and access to data, will begin January 1, 2014. The final rules outline the certification criteria for the certification of EHR technology, so eligible professionals and hospitals may be assured that the systems they use will work. The rule also helps them meaningfully use health information technology and qualify for incentive payments. In addition, the rules modify the certification program to cut red tape and make the certification process more efficient

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

What's New in Stage 2?

- **a.** With Stage 2, HHS expanded the meaningful use of EHR technology
- **b.** The Stage 2 criteria for meaningful use focuses on increasing the electronic capture of health information in a structured format, as well as increasing the exchange of clinically relevant information between providers of care at care transitions
- **c.** To accomplish such objectives, the rule maintains the same core and menu structures as were used in Stage 1
- **d.** The final rule contains 20 measures for physicians, of which 17 are core and 3 of 6 are menu objectives
- **e.** The final rule contains 19 measures for hospitals, of which 16 are core and 3 of 6 are menu
- **f.** The Stage 2 meaningful use final rule includes many measures aimed at improving quality and efficiency, reducing disparities, engaging patients, improving care coordination, safeguarding privacy and more
- **g.** The Stage 2 rule includes
  - **(1)** Changes to the denominator of computerized provider order entry (optional in Stage 1; required in Stage 2)
  - **(2)** Elimination of the "exchange of key clinical information" core objective from Stage 1 in favor of a "transitions of care" core objective that requires electronic exchange of summary of care documents in Stage 2 (new in Stage 2)
  - **(3)** Replacing "provide patients with an electronic copy of their health information" objective with a "view online, download and transmit" core objective (new in Stage 2)
- **h.** The Stage 2 rule also proposes new objectives that have greater applicability to many specialty providers
- **i.** The addition of these objectives recognizes the leadership role that many specialty providers have played in the meaningful use of health IT for quality improvement purposes with respect to
  - **(1)** Imaging results and information accessible through certified EHR technology
  - **(2)** Capability to identify and report cancer cases to a State cancer registry, except where prohibited, and in accordance with applicable law and practice
  - **(3)** Capability to identify and report specific cases to a specialized registry (other than a cancer registry), except where prohibited, and in accordance with applicable law and practice

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Proposed Stage 3

- **a.** As the goal for Stage 1 was data capture and patient access and information exchange and care coordination for Stage 2, the goal for Stage 3 Meaningful use is improved outcomes
- **b.** An ONC presentation in July 2013 outlines the adoption of a new model of care that is team based, outcome oriented and population management driven
- **c.** In addition, it should address national health priorities and have broad applicability
- **d.** The hope is that Stage 3 criteria will simplify and reduce reporting requirements and that adherence will rely more on market incentives to promote innovation and reward good behavior
- **e.** None of these Stage 3 recommendations have been finalized or released at the time of this chapter's publication, since the release of the NPRM has been postponed until late 2014

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Quality Measures

- **a.** One of the "meaningful use" criteria for both hospitals and physicians is the requirement to report clinical quality measures (CQMs) to either CMS (for Medicare) or to the States (for Medicaid)
- **b.** Quality measurement is considered one of the most important components of the incentive program under ARRA/HITECH
- **c.** The purpose of the health IT incentives is to promote reform in the delivery, cost, and quality of healthcare in the United States

d. Dr. David Blumenthal, the former national coordinator of health IT, emphasized this point when he said that "health IT is the means, but not the end. Getting an EHR up and running in healthcare is not the main objective behind the incentives provided by the federal government under ARRA. Improving health is. Promoting healthcare reform is"

e. For providers, the Stage 1 final rule lists 44 quality measures, with a requirement to report on six of them

f. For hospitals, Stage 1 meaningful use lists 15 measures, with a requirement to report on all of them (Medicare and Medicaid EHR Incentive Program)

g. Because HHS itself was not yet ready to electronically accept quality measure reporting in 2011, the Stage 1 rule specified that hospitals and eligible providers could submit summary information on clinical quality measures to CMS through attestation

h. For Stage 2, CMS posted its proposed clinical quality measures approximately one month after releasing the proposed rules in late February

i. To comply with Stage 2 meaningful use, physicians will have to measure 12 of the 125 clinical quality measures from various areas, including patient/family engagement, population health, and others

j. CMS noted on its Web site, "some of these measures are still in development; therefore, the descriptions provided … may change before the final rule is published"

k. Some of the measures had not been endorsed by the National Quality Forum (NQF), a nonprofit that HHS brought in to develop healthcare-related benchmarks, at the time of posting

l. Beginning in 2014, all providers, regardless of whether they are in Stage 1 or Stage 2 of meaningful use, will be required to report on the 2014 CQMs finalized in the Stage 2 rule

m. CMS has also provided information on what to report in 2013 as well as how to begin the transition for reporting in 2014

n. Beginning in 2014, all EPs and EHs beyond their first year of meaningful use will be required to submit CQMs electronically

o. Looking ahead to Meaningful Use Stage 3, the ONC Health IT Policy Committee is considering both e-clinical quality measures and the data intermediaries and standards to support them

p. The Policy Committee's Quality Measures Workgroup is tasked with developing recommendations for data intermediaries—and first and foremost to offer ONC leaders a sense of what the healthcare and health IT communities envision for intermediaries' roles

q. At the same time, data intermediaries will be encouraged to develop proprietary measurements—or novel ways of measuring quality, according to *Government Health IT News*

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

ONC and Establishment of the HIT Policy and Standards Committees

a. To drive the rapid, health IT-based reform under such an aggressive plan, the HITECH legislation reenergized ONC with specific accountabilities and significant funding

b. It also created the two new Federal Advisory Committees under its control: the HIT Policy Committee and the HIT Standards Committee, which have already been discussed in this chapter

c. Members of the two committees are public and private stakeholders who are tasked to provide recommendations on the HIT policy framework, standards, implementation specifications, and certification criteria for the electronic exchange and use of health information

d. Additional information regarding these two committees is provided in the next section: *HIT Federal Advisory Committees and Agencies*

e. ONC continues to stress the importance of working with all stakeholders to create workable plans

f. In the 2013 Federal Health IT Strategic Plan Report, ONC stated that its priorities will center on collaborating with Federal partners and private stakeholders to

  (1) Help providers, hospitals and other facilities, and others in the healthcare system to use tools and processes designed for the Meaningful Use EHR Incentive Program to achieve quality improvement goals in clinical practice and population health

  (2) Expand health information exchange and interoperability capacity

  (3) And increase patient engagement, using health IT to foster consumer confidence and equal partnerships in making health decisions

g. Many challenges remain. ONC and Federal partners will continue to engage with the public through open dialogue, including the Health IT Policy and Standards Committees, to address existing and emergent policy and market changes

h. One of the steps ONC took in 2013 to meet these challenges was the formation of three new workgroups

  (1) Accountable care

  (2) Consumer empowerment

  (3) And the Food and Drug Administration Safety and Innovation Act (FDASIA), which is a joint workgroup of ONC and the FDA

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Challenges to Achieving Widespread Health Information Exchange

a. The Information Exchange Workgroup (IEW) makes recommendations to the Health IT Policy Committee on policies, sustainability and implementation approaches to enhance the flow of health information

b. However, wide-scale interoperability challenges exist, leaving some primary care physicians and other providers with few options for meeting the health information exchange objectives included in meaningful use Stage 2 (MU2)

c. EHR vendors, along with the federal government and the states, are taking steps to address the interoperability issue and provide doctors and hospitals with the tools to meet the MU2 requirements, but progress is sometimes slow

d. The slow progress of EHR interoperability has not gone unnoticed in Congress

e. In October 2012, four powerful Republican members of the US House of Representative Ways and Means Committee wrote to Kathleen Sebelius, secretary of HHS

f. They expressed "serious concerns that MU2 rules fail to achieve comprehensive interoperability in a timely manner, leaving our healthcare system trapped in information silos. The letter urged Sebelius to suspend incentive payments and delay penalties until HHS promulgates universal interoperable standards"

g. The IEW addressed these issues at the April 2013 Health IT Policy Committee Meeting. Micky Tripathi, M.D., chair of the workgroup, said that new payment policies were beginning to create the business case and spur provider demand for information exchange

h. The workgroup recommended that HHS harmonize requirements for all the new payment models for public and private providers and offer supplemental payments to motivate switches to HIE activities

i. Gaps in HIE occur when providers are unable to exchange information with pharmacists, commercial labs, and other care settings such as behavioral health and long term-post acute care facilities that lack compatible exchange systems

j. The IEW recommended that HHS and CMS simplify and coordinate required documentation as well as provide incentives for HIE activities with these other providers and in these alternate venues

k. Another issue addressed by the IEW is the lack of cohesive program requirements across state-level programs, which inhibits seamless exchanges for multi-state providers and technology vendors

l. Tripathi said that variation may be the result of differences in programs that have federal and state components and/or where states have independent policy authority (e.g., privacy, liability, etc.)

m. The workgroup recommendations included that CMS include HIE requirements in all programs including state waivers

n. In addition, HHS should create model language for state programs and encourage harmony in state-level HIE policies

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Patient-Centered Outcomes Research

a. ARRA and HITECH increased funding by more than $1 billion for Comparative Effectiveness Research (CER) and established the Federal Coordinating Council for Comparative Effectiveness Research (FCC-CER)

b. This group is an advisory board comprised of clinical experts responsible for

  (1) Reducing duplication of efforts

  (2) Encouraging coordination and complementary uses of resources

  (3) Coordinating related health services research,

  (4) And making recommendations to the President and Congress on CER infrastructure needs

c. As part of this legislation, The Agency for Healthcare Research and Quality (AHRQ) received $1 billion of additional funding for CER

d. As one of 12 agencies within the Department of Health and Human Services

  (1) AHRQ supports research that helps people make more informed decisions and improves the quality of healthcare services

  (2) Some of AHRQ's funding must be shared with the National Institutes of Health (NIH) to conduct or support CER

e. Additional funding was also made available to the Patient-Centered Outcome Research Institute (PCORI)

  (1) A nonprofit, public-private partnership organization created by legislative authority in March 2010

  (2) To conduct research that would provide information about the best available evidence to help patients and their healthcare providers make more informed decisions

f. PCORI's research is intended to give patients a better understanding of the prevention, treatment, and care options available as well as the science that supports those options

g. In 2013, Joe Selby, MD, executive director, PCORI, reported at the June 5 Health IT Policy Committee on two funding announcements for up to $68 million

  (1) For Clinical Data Research Networks (CDRN) and Patient-Powered Research Networks (PPRN)

  (2) Of which $12 million would support up to 18 new or existing Patient-Powered Research Networks (PPRN) for 18 months

  (3) The research should involve patients with a single condition

  (4) The remaining $56 million would support up to eight new or existing Clinical Data Research Networks for 18 months

  (5) Each network should include at least two healthcare systems that are willing to participate in collaborative studies with data-sharing as part of a national research infrastructure and can enroll at least 1,000,000 patients enrolled

  (6) Both types of networks must be open to data standardized within network and with other awardees' networks; patients, system, and clinicians engaged in governance and use; and capable of implementing clinical trials

h. Currently, PCORI has approved 197 awards totaling more than 27 million to fund patient-centered CER projects

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Workforce Training

a. The rapid advancement toward a more technologically enabled healthcare system is driving a growing demand for health IT professionals
  (1) Highly skilled health IT experts
  (2) Who can support the provider community in the adoption and meaningful use of electronic health record

b. ONC funded the *Health IT Workforce Development Program*

c. The program's goal was to train a new workforce of health IT professionals who will be ready to help providers implement EHRs to
  (1) Improve healthcare quality
  (2) Safety
  (3) And cost effectiveness

d. It is even more important to pivot to integrated training of the incumbent workforce
  (1) Aimed at helping them understand how to use health IT as a tool to enable care delivery and payment reform

e. This was addressed during a report from the Workforce Workgroup of the Health IT Policy Committee in June 2013

Teaching Tip
Provide the following, example, Patricia Dombrowski, Bellevue College, reported on the adaptation of the curriculum for rural physician practices in rural and migrant clinics and for the VA. A five-hour online class was designed that VA employees could take, but on their own time. Nevertheless, the demand was high. An adaptation is being designed for community colleges to use with veterans with funding from the Department of Labor.

Teaching Tip
Provide the following example Norma Morganti and Rita Horwitz, Cuyahoga Community College, talked about role-based workforce competencies for patient-centered care via HIT and focusing on PCMH, HIE, meaningful use, and population management. The design is based upon input from subject matter experts and was facilitated with a partnership with Better Health Greater Cleveland. The resources were built to be widely distributed and used by educators and healthcare organizations that are ready to move to patient-centered care supported by health IT. For each role, there are competencies, learning objectives, and resources.

Consumer/Patient Engagement and eHealth

a. "Patient-centered care is considered one pillar of a high-performing, high-quality healthcare system. It is a key component of many efforts to transform care and achieve better population health. Expansion of health information technology and consumer eHealth tools—electronic tools and services such as secure e-mail messaging between patients and providers, or mobile health apps—have created new opportunities for individuals to participate actively in monitoring and directing their health and healthcare. [ONC] leads the strategy to increase electronic access to health information, support the development of tools that enable people to take action with that information, and shift attitudes related to the traditional roles of patients and providers"

b. In the article quoted above, the ONC authors wrote that patients who use electronic health tools tend to be more engaged in managing their care

c. Such patients tend to be better at finding the best quality and most cost-effective care

d. Such patients often they lack access, despite the increase in mobile technologies

e. ONC is working to
  (1) Expand access to personal health technologies
  (2) Promote a more collaborative partnership between patients and their healthcare providers
  (3) And boost awareness of patients' ability to request electronic access to their health data

NIH and NLM Grants to Support Health IT Research

a. The passage of ARRA and the HITECH Act provision earmarked
  (1) Substantial funding in support of health IT research
  (2) In addition to programs supporting health IT training

b. For its part, the NIH received an infusion of funds for 2009 and 2010 as part of ARRA

c. NIH had designated more than $200 million in these two years for a new initiative called the NIH Challenge Grants in Health and Science Research
  (1) This program supported research on topics that address specific scientific and health research challenges in biomedical and behavioral research that would benefit from significant, two-year jump start funds
  (2) NIH funded more than 200 grants, each up to $1 million, depending on the number and quality of applications

d. The National Library of Medicine (NLM) offers Applied Informatics grants to health-related and scientific organizations that wish to optimize use of clinical and research information

e. These grants help organizations leverage the capabilities of health IT
  (1) To bring usable, useful biomedical knowledge to end users
  (2) By translating the findings of informatics and information science research

    - **(3)** Into practice through novel or enhanced systems
    - **(4)** Incorporating them into real-life systems and service settings
- **f.** In April 2012, Donald A.B. Lindberg, MD, Director of the National Library of Medicine (NLM)
    - **(1)** Announced that NLM had awarded 14 five-year grants totaling more than $67 million for research training in biomedical informatics
    - **(2)** The discipline that seeks to apply computer and communications technology to improve health

SHARP Research Grants

- **a.** Alongside the NIH and NLM focus on incentivizing research
    - **(1)** ONC also made available $60 million to support the development of Strategic Health IT Advanced Research Projects (SHARP)
- **b.** The SHARP Program funds research
    - **(1)** Focused on achieving breakthrough advances
    - **(2)** To address well-documented problems that have impeded adoption of health IT
    - **(3)** And accelerating progress toward achieving the nationwide meaningful use of health IT
    - **(4)** In support of a high-performing, continuously-learning healthcare system
- **c.** ONC awarded four cooperative agreements of $15 million, with each awardee implementing a research program addressing a specific research focus area
    - **(1)** Health IT Security
    - **(2)** Patient-Centered Cognitive Support
    - **(3)** Healthcare Application and Network Architectures
    - **(4)** And Secondary Use of Health IT Data
- **d.** In 2012, ONC shifted the focus of SHARP grants to address the barriers to Meaningful Use in three major areas
    - **(1)** EHRs
    - **(2)** HIE
    - **(3)** Telemedicine
    - **(4)** With Personal Health Records (PHRs) as a major subtopic
- **e.** Another goal for the shift was to create an integrated security and privacy research IT community that can continue after the SHARP funding expires
- **f.** The program has worked to
    - **(1)** Automate complex decisions about sharing health records
    - **(2)** Develop ways to analyze personal health records access logs to catch policy violations
    - **(3)** And assure security and privacy in emerging telemedicine systems

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

STATE AND REGIONAL HEALTH IT PROGRAMS

1. Overview

- **a.** With recognition that the regional electronic exchange of health information is essential
    - **(1)** To the successful implementation of NwHIN
    - **(2)** To the success of national healthcare reform in general
    - **(3)** The HITECH Act authorized and funded a State HIE Cooperative Program
    - **(4)** And a Regional HIT Extension Program
- **b.** Taken together, these grant programs offer
    - **(1)** Much-needed local and regional assistance and technical support to providers
    - **(2)** While enabling coordination and alignment within and among states
- **c.** This will allow information to follow patients anywhere they go within the United States healthcare system

2. State Health Information Exchange Cooperative Agreement Program

- **a.** The State HIE Cooperative Agreement Program funds states' efforts to
    - **(1)** Rapidly build capacity for exchanging health information
    - **(2)** Across the healthcare system both within and across states
- **b.** Awardees are responsible for increasing connectivity and enabling patient-centric information flow to improve the quality and efficiency of care
- **c.** Key to this is the continual evolution and advancement of necessary governance, policies, technical services, business operations, and financing mechanisms for HIE over each state, territory, and SDE's four-year performance period
- **d.** This program is building on existing efforts
    - **(1)** To advance regional and state-level health information exchange
    - **(2)** While moving toward nationwide interoperability
- **e.** On January 27, 2011, an additional $16 million was made available to states through ONC's new Challenge Grants program
    - **(1)** This program will provide funding to states
    - **(2)** To encourage breakthrough innovations for health information exchange
    - **(3)** That can be leveraged widely to support nationwide health information exchange and interoperability
- **f.** A major challenge for state health information exchanges
    - **(1)** Is the question of sustainability
    - **(2)** How will they survive once federal and state grants terminate
- **g.** To this end, the National Association of State Chief Information Officers (NASCIO) and HIMSS collaborated on a study of state level health information exchanges, the results of which were released in June 2013
    - **(1)** The study showed that most states still rely on federal and state grants; however, some are becoming independent

    - **(2)** The study surveyed 26 US states and territories about their health IT structures and programs
    - **(3)** Most of the responding states, 58 percent, indicated that they had designated third parties to develop health exchanges in their states
    - **(4)** The rest of those surveyed said the state owned and operated the HIE
    - **(5)** Most of the states that reported having active HIEs were those who had a designated third party operating their exchanges
    - **(6)** State-run HIEs relied heavily on subscription fees,
    - **(7)** The third-party-managed exchanges had a broader base of revenue, including membership dues and licensing fees as well as subscription fees
    - **(8)** The third-party run exchanges sustain funding for operation by meeting the needs of the market, or the needs of hospitals and other providers to share health information
  - **h.** "So how will state-level HIEs achieve sustainability? The model for success is already in place in some of the more successful HIEs across the country, who understand that the exchange of health information is only one of many services healthcare organizations find valuable"

3. Beacon Communities

  - **a.** Also funded by HITECH, ONC's Beacon Community Program will help guide the way to a transformed healthcare system
    - **(1)** The program is working to fund more than a dozen demonstration communities that have already made inroads into the adoption of health IT, including EHRs and health information exchange
    - **(2)** Beacon Communities are designed to advance new, innovative ways to improve care coordination, improve the quality of care, and slow the growth of healthcare spending
    - **(3)** Their goals are to show how health IT tools and resources can contribute to communities' efforts and make breakthrough advancements in healthcare quality, safety, efficiency, and in public health at the community level, demonstrating that these gains are sustainable and replicable
  - **b.** In 2010, ONC awarded $250 million in grants over three years to 17 selected communities throughout the United States
  - **c.** These communities have already made inroads in the development of secure, private, and accurate systems of EHR adoption and health information exchange
  - **d.** Each of them, with its unique population and regional context, is actively pursuing the following areas of focus
    - **(1)** Building and strengthening the health IT infrastructure and exchange capabilities within communities, positioning each community to pursue a new level of sustainable healthcare quality and efficiency over the coming years
    - **(2)** Translating investments in health IT in the short run to measureable improvements in cost, quality and population health
    - **(3)** Developing innovative approaches to performance measurement, technology and care delivery to accelerate evidence generation for new approaches
  - **e.** In February 2013, the HIT Policy Committee noted that all 17 communities of the Beacon Communities
    - **(1)** Have at least two measures trending positively
    - **(2)** And the launch of new exchange capabilities in communities like New Orleans and San Diego
  - **f.** The collaboration has enabled 51 primary care practice locations
    - **(1)** Representing 432 providers and 447,000 patients to exchange a consistent patient summary care document
    - **(2)** To better manage transitions of care and to populate community data repositories or registries

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. Health IT Regional Extension Program

  - **a.** The HITECH Act authorized a Health Information Technology Extension Program, which consists of Regional Extension Centers (RECs) and a national Health Information Technology Research Center (HITRC)
    - **(1)** The regional centers offered technical assistance, guidance, and information on best practices to support and accelerate healthcare providers' efforts to become meaningful users of Electronic Health Records (EHRs)
    - **(2)** The extension program established 62 regional centers, each serving a defined geographic area
    - **(3)** The regional centers supported over 120,000 primary care providers through participating nonprofit organizations in achieving meaningful use of EHRs and enabling nationwide health information exchange
  - **b.** The Extension Program also established a HITRC
    - **(1)** Funded separately
    - **(2)** To gather relevant information on effective practices
    - **(3)** Help the regional centers collaborate with one another and with relevant stakeholders
    - **(4)** To identify and share best practices in EHR adoption, effective use, and provider support
  - **c.** In addition to helping individual and small practice providers, RECs are helping critical-access hospitals and other rural hospitals with targeted technical systems
    - **(1)** These hospitals are important, because almost one-fifth of the American population lives in rural areas
    - **(2)** However, they face unique challenges because of their remote geographic locations, small sizes and low patient volumes, limited workforces, shortages of clinicians, constrained financial resources, and lack of affordable, adequate connectivity
    - **(3)** To help critical access and rural hospitals overcome these obstacles, ONC and the RECs offer a number of tools on the ONC Web site

- **d.** As of July 2013, more than 147,000 providers are currently enrolled with a Regional Extension Center
  - **(1)** Of these, more than 124,000 are now live on an EHR and more than 70,000 have demonstrated Meaningful Use
  - **(2)** Some 41 percent of PCPs nationwide are enrolled with a REC; 51 percent of rural PCPs are enrolled
  - **(3)** Of these 85 percent of REC-enrolled providers are live on an EHR versus 62 percent live on an EHR in the general provider population
- **e.** The RECs participate in eight "Community of Practice" working groups on emerging business lines in support of practice transformation including
  - **(1)** Privacy and security
  - **(2)** Accountable care organizations
  - **(3)** Patient centered medical home
  - **(4)** Health information exchange
  - **(5)** And patient engagement

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

HEALTH IT FEDERAL ADVISORY COMMITTEES AND AGENCIES

1. Overview

- **a.** In 1972, decades before ARRA, HITECH, and ACA
  - **(1)** The Federal Advisory Committee Act became law and is still the legal foundation defining how Federal Advisory Committees and Agencies (FACAs) should operate
  - **(2)** As then prescribed, the characteristics of such groups included openness and inclusiveness
  - **(3)** Specific authorization by either the President or the head of the overseeing agency, transparency, and clearly defined timelines for operation, termination, and renewal
- **b.** In 2009, as mandated by ARRA and HITECH
  - **(1)** ONC created two new Federal Advisory Committees
  - **(2)** The HIT Policy Committee and the HIT Standards Committee
  - **(3)** In order to gain broad input on the use of health IT to support healthcare reform
- **c.** It is these committees, their leaders, and members who are changing the infrastructure of health IT across the nation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. The Health IT Policy Committee

- **a.** The HIT Policy Committee is charged with making recommendations to ONC on a policy framework
  - **(1)** For the development and adoption of a nationwide health information infrastructure
  - **(2)** Including standards for the exchange of patient medical information
- **b.** Originally serving the Committee were seven workgroups to address and make recommendations to the full committee on key reform issues such as
  - **(1)** Meaningful use of EHRs
  - **(2)** Certification and adoption of EHRs
  - **(3)** Information exchange
- **c.** NwHIN, the strategic plan framework, privacy and security policy, and enrollment in Federal and State health and human services programs
- **d.** As the ONC has taken on a number of issues to expand and protect the future of health IT in America
  - **(1)** Those 7 groups have grown to 14
  - **(2)** Including new workgroups for accountable care, consumer empowerment, and FDSIA
- **e.** With the adoption of EHRs a primary concern for health IT
  - **(1)** The Meaningful Use workgroup is currently weighing the issues for MU Stages 3 and 4
- **f.** The ultimate goal is
  - **(1)** Secure
  - **(2)** Accessible information for providers and patients to aid in quality healthcare

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. The Health IT Standards Committee

- **a.** The HIT Standards Committee is charged with making recommendations to ONC on
  - **(1)** Standards
  - **(2)** Implementation specifications
  - **(3)** And certification criteria for the electronic exchange and use of health information
- **b.** In harmonizing or recognizing standards and implementation specifications
  - **(1)** The HIT Standards Committee is also tasked with providing for all associated testing by the National Institute of Standards and Technology (NIST)
- **c.** Originally serving the Committee are four workgroups addressing
  - **(1)** Clinical operations
  - **(2)** Clinical quality
  - **(3)** Privacy and security requirements
  - **(4)** And implementation strategies that accelerate the adoption of proposed standards

d. The Committee has now expanded to eight workgroups, to include ones focused on
  (1) Patient engagement
  (2) Consumer technology
  (3) NwHIN
  (4) And vocabulary for this emerging field

e. With the increased emphasis on accountable care
  (1) A new diagnostic coding system
  (2) And Meaningful Use of EHRs
  (3) The clinical and health technology sectors are feeling the crunch

f. In February 2013, members of the HIT Standards Committee
  (1) Felt that rather than operate independently
  (2) They needed to coordinate more with the Policy Committee

g. The Committee decided to work toward a proposal with the HIT Policy Committee that would include these elements
  (1) Capability that needs to be broadly adopted to support national goals
  (2) Programmatic alignment for that capability (e.g., MU3/4, ACO/PCMH, etc.) both at the Federal/state and commercial levels
  (3) Suggested timeline for adoption of the capability (where the timeline includes stakeholder alignment, standards development, technology development, deployment, and adoption)

h. Currently, both Committees are working on priorities for Meaningful Use Stage 3

i. In addition to the HIT Policy and Standards Committees, two other key groups are involved in the national healthcare reform movement, including
  (1) The National Committee on Vital and Health Statistics
  (2) And the National Quality Forum

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. The National Committee on Vital and Health Statistics

a. The National Committee on Vital and Health Statistics (NCVHS) was originally established more than 60 years ago by Congress to serve as an advisory body to the HHS on
  (1) Health data
  (2) Statistics
  (3) And national health information policy

b. It fulfills important review and advisory functions
  (1) Relative to health data and statistical problems of national and international interest
  (2) Stimulates or conducts studies of such problems
  (3) Makes proposals for improvement of US health statistics and information systems

c. In 1996, NCVHS was restructured to meet expanded responsibilities under HIPAA

d. In 2009, the committee was the first to hear testimony and make recommendations to ONC on meaningful use criteria to measure effective EHR use

e. NCVHS is the driving force behind the implementation of ICD-10
  (1) A new set of codes for medical diagnoses and inpatient stays

f. Because other areas of health IT depend on the coding system
  (1) NCVHS recommended that HHS not delay ICD-10
  (2) Which is set to begin October 1, 2014

g. The Committee also recommends
  (1) Education
  (2) Outreach
  (3) And practical guidance for those who must adopt the new standards

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. The National Quality Forum

a. The National Quality Forum (NQF) is a nonprofit organization that aims to improve the quality of healthcare for all Americans through the fulfillment of its three-part mission to
  (1) Set national priorities and goals for performance improvement
  (2) Endorse national consensus standards for measuring and publicly reporting on performance
  (3) Promote the attainment of national goals through education and outreach programs

b. NQF has taken the lead in defining the quality measures to qualify for the meaningful use incentives under HITECH

c. NQF is working with the HIT Standards Committee
  (1) To determine specific goals and deliverables for the second revision of Health Level Seven International (HL7)

d. HL7 is the global authority on standards for interoperability of health information technology with members in more than 55 countries

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

NURSING INFORMATICS AND HEALTHCARE REFORM

1. Overview

a. In 2009, a survey sponsored by HIMSS' Nursing Informatics community entitled the *Informatics Nurse Impact Survey* concluded that the passage of the ARRA and its provision of incentives to promote the meaningful use of EHRs created new opportunities for informatics nurses "to apply their ability not only to understand all sides of the IT process, but to act as a translator between those who understand the language of the technology and the language and needs of clinicians and patients"

b. HIMSS reinforced this stance in 2011 when it released its Position Statement on Transforming Nursing Practice through Technology and Practice that said in part, "Nurses are key leaders in developing the infrastructure for effective and efficient health information technology that transforms the delivery of care. Nursing informatics professionals are the liaisons to successful interactions with technology in healthcare"

c. For years, informatics nurses have contributed to

(1) The work of healthcare reform implementation teams

(2) Creating constantly stronger positions from which to help put the new national healthcare infrastructure in place

d. Given the aggressive timeframes written into the new healthcare reform legislation

(1) However, collaboration between public and private healthcare entities has never been more important

e. This call to action in the transformation of the healthcare industry has raised the visibility of

(1) A number of respected nursing and nursing informatics professional organizations

(2) Whose missions seek to advance the practice of informatics nurses and strengthen the profession's collective voice and impact

f. This section highlights some of the involvement that nurses have had in the work of HIT and healthcare reform

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. Nursing Informatics Competencies

a. Today's informatics nurse combines clinical knowledge with IT to improve the ways nurses diagnose, treat, care for, and manage patients

b. Informatics nurses support, change, expand, and transform nursing practice through the design and implementation of information technology

c. The ANI defines nursing practice as "a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge, and wisdom in nursing practice"

d. In the transforming healthcare industry environment

(1) Informatics nurses help to design the automated tools that help clinicians, nurse educators, nursing students, nurse researchers, policymakers, and consumers as they increasingly seek to manage their own health

e. It is essential that a nursing culture

(1) That promotes the acceptance and use of information technology

(2) Is sustained and advanced by establishing informatics nurse competencies and the educational processes that help nurses achieve them

f. Many in the profession emphasize the need for every nurse, whether employed in a practice or educational setting, to develop a minimum or "user" level of computer literacy and informatics theory

g. A second tier includes the intermediate level of literacy, which includes nurses who may work part time on teams to design, modify, or evaluate HIT systems

h. The third level of competency is the advanced or innovator level where a nurse has begun to specialize

i. A more complete discussion of competencies and competency development for nurses is provided elsewhere in this book

j. It is important to note that the informatics competencies described here are for nurses and nurse leaders, not informatics nurses

k. Practicing nurses' understanding of the role HIT plays to drive quality care and healthcare reform directly impacts their adoption of HIT and their definition of best practice use of HIT

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. The Intersection of HIT Policy and Nursing Informatics

a. Informatics nurses are poised to play pivotal leadership roles in defining new policies that help to make the goals of ARRA and HITECH a reality over coming years

b. To make such a profound difference in today's constantly changing healthcare environment, informatics professionals must be aware of existing and proposed healthcare policy on an ongoing basis

c. Policy is defined as

(1) A course of action that guides present and future decisions

(2) Is based on given conditions

(3) And is selected from among identified alternatives

d. Healthcare policy is established

(1) On local, state, and national levels

(2) To guide the implementations of solutions for the population's health needs

e. Both existing conditions and emerging trends in the healthcare industry influence policy decisions

f. Policy decisions often establish the direction for future trends that impact informatics

g. Informatics nurse professionals, therefore, must become more cognizant of events and the healthcare policies that will affect their practice

h. As aptly summarized by one of nursing's most active and respected organizations, the ANI, "...'meaningful use' of HIT, when combined with best practice and evidence-based care delivery, will improve healthcare for all

Americans. This is an essential foundation for the future of nursing, and informatics nurses must be engaged as leaders in the effective use of information technology to impact the quality and efficiency of healthcare service"

4. **Influencing Health IT Transformation through Testimony and Comment**

Teaching Tip
Provide this reminder to the students, this chapter has discussed the need for health IT competencies, awareness of how health IT is changing the way we diagnose, treat, care for, and manage patients, as well as healthcare policies that affect healthcare practices and the global healthcare landscape. In addition, healthcare informatics professionals should never underestimate the power of communication to bring about meaningful change in our Nation's healthcare delivery system.

a. In 2005, the World Health Organization's Commission on the Social Determinants of Health asked, "What narrative will capture the imaginations, feelings, intellect and will of political decision-makers and the broader public and inspire them to action?"
  (1) Years later, the question is more important than ever to the health IT professionals who stand in an unprecedented position to effect change
  (2) Public comment through the growing number of media outlets—supported by the emergence of the internet and social media—translates theory and knowledge into meaningful activity that can drive and define local, state and federal policy, addressing key health and social issues and improving the lives of patients affected by them

b. Outlets for communications that can reach pivotal society segments and the ears of key individual influencers in healthcare reform include
  (1) Not only traditional media (newspapers, magazines, books)
  (2) But also new mass media formats like Web-based video and blogs, Twitter, and other social media sites

c. Whether commenting
  (1) Over these outlets from organizations like HIMSS or AMIA
  (2) Or as an individual active in healthcare transformation
  (3) Such communication can change public perceptions of current issues and help form and influence public attitudes and decisions

d. Many health IT agencies also collaborate with and testify to federal committees to influence healthcare laws
  (1) In July 2013, HIMSS commented on the Senate Finance Committee's hearing on Healthcare Quality
  (2) While agreeing with the federal government's desire and plan to move toward quality healthcare, HIMSS urged the Finance Committee to focus on solidifying the Health IT infrastructure before introducing new quality measures
  (3) Paul Ginsberg of the Center for Studying Health System Challenges testified before the US Senate Committee on Finance regarding the high price and low transparency of healthcare costs
  (4) The June 18, 2013 testimony came before the rollout of the Health Insurance Exchange in October and touch on one of the key issues of the new ACA

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

THE ROAD AHEAD

a. Leaders in healthcare agree
  (1) The future depends on a system that will continue to innovate using health IT
  (2) To rely on informatics
  (3) To play instrumental roles in patient safety, change management, and quality improvement
  (4) As evidenced by quality outcomes, enhanced workflow, and user acceptance

b. These areas highlight
  (1) The value of an informatics-trained workforce
  (2) Their roles in the adoption of health information technologies
  (3) That deliver higher quality clinical applications across healthcare organizations

c. That value can only increase as new directions and priorities emerge in healthcare

d. In an environment where the roles of all healthcare providers are diversifying, informatics nurses must prepare to guide the profession appropriately from their positions as
  (1) Project managers
  (2) Consultants
  (3) Educators
  (4) Researchers
  (5) Product developers
  (6) Decision support and outcomes managers
  (7) Chief clinical information officers
  (8) Chief information officers
  (9) Advocates
  (10) Policy developers
  (11) Entrepreneurs
  (12) Business owners

e. This is especially true where informatics nurses can contribute leadership in the effective design and use of EHR systems

f. To achieve our nation's healthcare reform goals
  (1) The healthcare community must leverage the sources of patient-care technologies
  (2) And information management competence that informatics nurses provide

   - **(3)** To insure that the national investment in HIT and EHRs is implemented properly and effectively over coming years

- **g.** In its October 2009 recommendations to the Robert Wood Johnson Foundation (RWJF) on the future of nursing
   - **(1)** The ANI argued that nurses will be integral to achieving a vision that will require a nationwide effort to adopt and implement EHR systems in a meaningful way
   - **(2)** "This is an incredible opportunity to build upon our understanding of effectiveness research, evidence-based practice, innovation and technology to optimize patient care and health outcomes. *The future of nursing will rely on this transformation, as well as on the important role of nurses in enabling this digital revolution*"
- **h.** For no professional group does the future hold more excitement and promise from so many productive perspectives than it does for informatics nurses

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CHAPTER REVIEW

- The passage of landmark healthcare reform legislation including ARRA and the HITECH Act in 2009 and ACA in 2010
    - As upheld by the US Supreme Court on June 28, 2012
    - Have changed the landscape of the US healthcare industry forever,
    - perhaps more than any expert envisioned just scant years ago
- The Obama Administration's hard-fought legislative success
    - Is testimony to the growing recognition that advanced health IT
    - Is essential to support the enormous amounts of electronic information
    - That will be collected and exchanged will be foundational to industry transformation and healthcare reform
- As the massive transformation from
    - Disconnected, inefficient, paper-based "islands" of care delivery
    - In a nationwide, interconnected and interoperable system driven by EHRs and health IT innovation
    - The importance of nurses and nursing informatics has become increasingly evident
- For decades, nurses have proactively contributed resources to the
    - Development
    - Use
    - And evaluation of information systems
- Today, they constitute the
    - Largest single group of healthcare professionals
    - And include experts who serve on national committees and initiatives focused on HIT policy, standards and terminology development, standards harmonization, and EHR adoption
- Performing their front-line roles, nurses will continue to have a profound impact
    - On the quality and effectiveness of healthcare
    - And are emerging as leaders in the effective use of HIT to improve the quality and efficiency of healthcare services

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Discuss the significant impact of federal legislation from 2009 and 2010 on the use of health information technology
- Describe the creation of the office of the National Coordinator for Health Information Technology and summarize the major role it plays in the implementation of health information technology
- Discuss the implications of policy on nursing informatics as a specialty
- Identify the impact that national trends and events focused on information and information technology have on nursing informatics practice
- Outline the role of health IT in key emerging payment and clinical practice change initiatives; both in the government and in the private sector

Teaching Tip
Ask the students to define the keywords

- Informatics
- Health information technology
- Public policy
- Health policy
- Electronic health record
- HITECH

CHAPTER REVIEW QUESTIONS

Question 16.1: What is considered to be the earliest event that initiated the Forces of Change in Today's National Healthcare System?

- **a.** The enactment of the HIPAA Privacy Rule
- **b.** The publishing of the IOM Report "Computer-based Patient Record"
- **c.** The creation of the President's Information Technology Advisory Committee (PITAC)
- **d.** The establishment of the Office of the National Coordinator (ONC)

Question 16.2: Which President established the goal of an Electronic Health Record for every American by 2014 in his Inaugural Address?

a. President George W. Bush
b. President William Clinton
c. President Barack Obama
d. President George H. Bush

Question 16.3: HIPAA which was passed in 1996 focused on what aspect of healthcare?

a. Develop regulations protecting the privacy and security of electronic health information True ___ False ___
b. Enacted the HIPAA Privacy Rule and HIPAA Security Rule True ___ False ___
c. HIPAA impacted health informatics by preventing patients from accessing their own medical records True ___ False ___
d. Established national standards for the protection of individually identifiable health information True ___ False ___
e. Established national security to protect the privacy of individuals True ___ False ___

Question 16.4: What was the earliest event/activity initiated by ONC that focused on HIT?

a. Created the Certification Commission for Healthcare Technology (CCHIT)
b. Established Exchange Standards via CMS
c. Established Policy Committee and Standards Committee
d. Determined the need for EHR Interoperability

Question 16.5: Which groups were involved in HIT and influential in the enactment of the ARRA/ HITECH Act of 2009?

a. NCVHS, NwHIN, AHQR and CMS
b. CMS, NLN, CCHIT, ONC, and NCVHS
c. CCHIT, PITAC, ONC, NwHIN, and HIPAA
d. HIPAA, ONC, CCHIT, and NLN

Question 16.6: The ARRA and HITECH Act of 2009 was passed designed to rescue and reform the nation's ailing healthcare industry. What was the key features that stimulated the growth of HIT in the country?

a. Offered financial incentives to help healthcare providers purchase and Implement HIT and HER Systems True ___ False ___
b. Impose penalties beyond 2015 for hospitals and physicians who failed to adopt use of EHRs True ___ False ___
c. ONC and NLN were given the responsibility of administering the HITECH Act of 2009 True ___ False ___
d. The ONC used HITECH funds for hospitals and healthcare professionals who had adopted and been certified as implementing EHR technology True ___ False ___
e. The ONC initiated a dynamic evolutionary process that involved two "meaningful use" stages True ___ False ___

Question 16.7: The final criteria for "Meaningful Use" Stage 1 as divided in what five major initiatives? (Only one key item from each is listed)

a. Care Coordination, Privacy/Security, Interoperability, Public Health, and Patients/Families
b. Public Health, Patients/Families, CPOE, Care Coordination, and Interoperability
c. Quality/Safety, Patients/Families, Care Coordination, Public Health, and Privacy/ Security
d. Quality/Safety, Public Health, Privacy/Security, CPOE, and Interoperability

Question 16.8: The HHS/ONC included many new measures for "Meaningful Use" Stage 2; the major ones were aimed at what?

a. Reduce Disparities, Safeguard Privacy, Insure Interoperability, and Discharge Summary
b. Improve Quality/Security, Reduce Disparities, Improve Care Coordination, and Safeguard Privacy
c. Improve Care Coordination, Insure Interoperability and Discharge Summary, and Safeguard Privacy
d. Safeguard Privacy, Insure Interoperability, Improve Quality/Security, and Reduce Disparities

Question 16.9: Clinical quality measures (CQMs) have been included in "Meaning Use" criteria, several of which were required for Stage 2 to be completed in 2014/2015. The CQMs were developed by the National Quality Forum (NQF). Which is the correct answer?

a. Meaningful Use Stage 2 requires for physicians to comply must measure at least 12 of 125 Clinical quality measures (CQMs) developed by National Quality Forum (NQF)
b. Meaningful Use Stage 1 requires for physicians to comply must measure at least 15 of the 125 Clinical Quality Measures developed by National Quality Forum
c. Meaningful Use Stage 3 requires for Physicians to comply must measure at least 5 of the 125 Clinical Quality Measures developed by National Quality Forum
d. Meaningful Use Stage 2 requires for Physicians to comply must measure none of the 125 Clinical Quality Measures developed by National Quality Forum

Question 16.10: What role does Nursing Informatics play in defining new policies and goals of ARRA and HITECH in the coming years?

a. Informatics nurses must engage as leaders in defining new policies that help make ARRA and HITECH a reality in the future True ___ False ___

b. Informatics nurses must engage as leaders in the effective use of IT to impact the quality and efficiency of healthcare service True ___ False ___

c. Informatics nurses must become cognizant of events and healthcare policies that affect their practices True ___ False ___

d. Informatics nurses serve as key leaders in developing the infrastructure for effective and efficient HIT that transforms the delivery of care in today's changing healthcare environment True ___ False ___

Answers and Explanations

Question 16.1: (b) The publishing of the IOM Report "Computer-based Patient Record." In 1991 the IOM concluded that computerization could help improve patient records and information management leading to higher quality of care in its landmark report: The Computer-Based Patient Record: As essential Technology for Healthcare.

Question 16.2: (a) President George W. Bush. On January, 20 2004, President George W. Bush in his State of the Union address called for an Electronic Health Record for every American by the year 2014. He went on the issue and Executive Order and established the Position of National Information Technology Coordinator.

Question 16.3: HIPAA which was passed in 1996 focused on what aspect of healthcare?

a. True

b. True

c. False

d. True

e. True

HIPAA's goals are to allow the flow of health information needed to provide and promote high quality healthcare while protecting public's health and well-being.

Question 16.4: (c) Established Policy Committee and Standards Committee. Once the ONC was established on 2004, the first coordinator, Dr. Brailer was appointed by the then Tommy Thomson then Secretary of HHS. The ONC became the principal federal entity to become the key play in the execution of the ARRA and HITECH Act of 2009. It authorized the creation of two committees the Health IT Policy Committee and the HIT IT Standards Committee-that make recommendations to the ONC.

Question 16.5: (c) CCHIT, PITAC, ONC, NwHIN, and HIPAA. HIPAA which initially took effect in 1996 and then passed its HIT Privacy and Security rule in 2003; PITAC was established in 1997 when an executive Order established a visionary 24—member which comprised corporate and academic leaders in order to advance information technology; ONC was established in 2004 to promote HIT; CCHIT was also founded in 2004 with support from three industry associations—AHIMA, HIMSS, and NAHIT—to develop certification criteria and inspection through a voluntary process for EHRs; and finally HwHIN was established in 2005 to create a nation-wide, interoperable, private, and secure exchange of health information between EHRs.

Question 16.6:

a. True

b. True

c. False

d. True

e. False

Question 16.7: (c) Quality/Safety, Patients/Families, Care Coordination, Public Health, and Privacy/ Security. On July 28, 2010 after reviewing more than 2000 comments, HHS issued the Stage 1 Final Rule, with final criteria for meeting "Meaningful Use" into five initiatives which are listed on page 258.

Question 16.8: (b) Improve Quality/Security, Reduce Disparities, Improve Care Coordination, and Safeguard Privacy. Meaningful Use Stage 2 focused on increasing the electronic capture of health information in a structured format as well as increasing the exchange of clinical relevant information between provides of care at care transitions.

Question 16.9: (a) Meaningful Use Stage 2 requires for physicians to comply must measure at least 12 of 125 Clinical quality measures (CQMs) developed by National Quality

Forum (NQF). CMS noted that on its web site' some of these measures are still in development therefore the descriptions provided many change before the final rule. Some of the measures has not been endorsed by NQF, a non-profit that HHS brought in to develop healthcare-related benchmarks.

Question 16.10:

a. True

b. True

c. True

d. True

PART 4

Nursing Informatics Leadership

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17

The Role of the Nurse Executive in Information Technology Decision Making

• OBJECTIVES

1. Why the technology lifecycle virtually assures perpetual healthcare information technology (HIT) decision-making in healthcare delivery environments.
2. The need for executive nurses to commit to lifelong learning if they are to participate and actively lead HIT decision-making.
3. The two most important HIT processes that demand nurse executive involvement.
4. Where to turn for help in developing and maintaining a nursing-centric, deep HIT competency.
5. The value that only nurse executives, acting as the all-important "voice of the patient," bring to HIT decision-making.

• KEY WORDS

Technology lifecycle
Process mapping
Workflow designs
Nursing-centric HIT expertise
Voice of the patient
Nursing Informatics

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Who should be involved in the selection of health information technology? What is the role of the nurse executive in the selection and use of health information technology? Should the nurse executive be an expert in health information technology? How would the nurse executive use data and information to improve clinical care?

For a WIIFM statement, say to the class, "In this chapter, to productively contribute and, ultimately, drive technology decisions, nurse executives need to be constantly updating and advancing their hospital information technology (HIT) knowledge. This knowledge needs to go beyond baseline functionality-level information of nursing and clinical information systems, which describes what systems can accomplish, to more a complex understanding of enterprise-wide integration, data and process mapping, and business analytics. Commanding a deep well of HIT expertise helps nurse executives understand the delicate interplay of nursing and outcome data inside the healthcare organization and beyond—to the regulator and payer worlds.

Few industries collect, analyze, and disseminate information with the velocity seen in healthcare and in no industry does the data-driven decision have more importance. In healthcare, every patient care decision can have a life-and-death implication. That's why the timely communication of accurate data plays such a critical role in healthcare delivery.

As a nurse, it is important to understand the role of the nurse executive in the selection, implementation, and evaluation of health information technology as well as the use of data and information to improve healthcare.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to visit relevant Internet Web sites

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

Teaching Tip

Provide this information as an introduction to the chapter if not provided in the gaining attention and establishing common ground, to productively contribute and, ultimately, drive technology decisions, nurse executives need to be constantly updating and advancing their hospital information technology (HIT) knowledge. This knowledge needs to go beyond baseline functionality-level information of nursing and clinical information systems, which describes what systems can accomplish, to more a complex understanding of enterprise-wide integration, data and process mapping, and business analytics. Commanding a deep well of HIT expertise helps nurse executives understand the delicate interplay of nursing and outcome data inside the healthcare organization and beyond—to the regulator and payer worlds.

Few industries collect, analyze, and disseminate information with the velocity seen in healthcare and in no industry does the data-driven decision have more importance. In healthcare, every patient care decision can have a life-and-death implication. That's why the timely communication of accurate data plays such a critical role in healthcare delivery.

1. Flawed thinking
    - **a.** Most nurse executives view technology-related decision-making
        - (1) As an episodic responsibility
        - (2) That takes place once every 7 to 10 years
        - (3) The time frame when major HIT systems are replaced
    - **b.** However, this widely held assumption could not be further from the truth
    - **c.** In the lived experience, technology decision-making happens with regularity throughout the year—every year
    - **d.** From an executive nurse perspective
        - (1) The complexity of HIT
        - (2) Coupled with the speed of innovation and the rapid adoption of emerging technologies
        - (3) Require that theoretical and applied knowledge of HIT is up-to-date at all times
    - **e.** As the largest "user group" in most healthcare organizations
        - (1) Nursing feels the impact of technology decisions
        - (2) Faster and more often than other user populations in the healthcare organization
    - **f.** The intricate and interwoven nature of the healthcare technology
        - (1) Especially those systems directly involved in managing, monitoring, and tracking patient care
        - (2) Makes even what appears to be a "small decision" an important one
    - **g.** Technology selections and deployments
        - (1) With their organizationally transformative potential
        - (2) Come with wide-reaching impacts that can be felt for decades

Teaching Tip

Use the following example, consider the decision to upgrade a messaging technology, which would be viewed by many executives as a "small decision."

    - **h.** The speed with which nursing data needs to be communicated, and its inherent criticality
        - (1) Can transform the inevitable glitches in new technology introduced into minefields for patient care
        - (2) That reaches far beyond the organizational boundaries of nursing
    - **i.** In addition to the potential impact on patient care the "simplest" technology decision has
        - (1) Consider all the third parties outside the healthcare organization
        - (2) That depend on it for documentation of activities, results and outcomes
    - **j.** A variety of regulator- and payer-specified formats
        - (1) Drive how this documentation must be reported
        - (2) Further complicating results and outcome reporting
    - **k.** Financial reimbursement
        - (1) The lifeblood of the healthcare organization
        - (2) Literally hangs in the balance for all but the rare privately funded institution

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. Technology's lifecycle
    - **a.** To better understand
        - (1) The incessant nature and far-reaching impact of technology-related decisions
        - (2) Consider the six-stage Technology Lifecycle
    - **b.** The lifecycle of every technology investment spans six distinct phases
        - (1) Planning
        - (2) Procurement
        - (3) Deployment
        - (4) Management

  - **(5)** Support
  - **(6)** Disposition
  - **(7)** Only to cycle back to planning
- **c.** However, various “stops” and “starts”
  - **(1)** Some are internally caused
  - **(2)** Others are triggered externally
- **d.** Issues that did not surface during “Planning” or “Procurement”
  - **(1)** Make themselves known during “Deployment,” “Management,” “Support,” or even “Disposition”
  - **(2)** Wreaking havoc on the most well-conceived implementation plan
- **e.** Overlaying this lifecycle with an ever present technology obsolescence complicates technology-related decision-making further
- **f.** Three key types of obsolescence exist
  - **(1)** Technology providers’ architecture, product, and integration plans
  - **(2)** Third parties’ priority shifts
  - **(3)** Regulators’ unexpected recalls
- **g.** The impact of planned obsolescence cannot be overlooked when nurse executives make HIT-related decisions
- **h.** Technology providers worldwide require engineers to
  - **(1)** Design obsolescence into their systems
  - **(2)** To ensure ongoing market demand
  - **(3)** Protect market share
  - **(4)** Preserve revenue streams
- **i.** Technology providers with nurse executives on staff tend to exercise considerable influence over
  - **(1)** Architecture
  - **(2)** Product
  - **(3)** Integration efforts
- **j.** However, those without such internal nursing advocates may find nursing issues significantly overshadowed by the
  - **(1)** Financial and business pressures
  - **(2)** Public and privately held technology companies face
- **k.** In addition to providers’ planned obsolescence, systems face
  - **(1)** Being updated
  - **(2)** Or even phased out when the external market landscape changes

Teaching Tip

Provide the following information, consider the massive overhaul needed to move financial information systems from a cost-plus orientation to a system of capped reimbursement. Virtually overnight, healthcare organizations had to replace large, charge-capture legacy systems with technology that could accurately predict total costs by procedure. Shifts in regulatory- or payer-related priorities can trigger a range of system changes from code revisions all the way up to system replacement. When healthcare organizations face significant penalties, such as funding losses or reductions, fines and legal consequences, and fiscal threats to their very existence, noncompliance is not an option. Complying with these environmental mandates can throw technology lifecycles into free fall as legacy systems struggle to accommodate regulator or payer mandates that were nowhere on the horizon when these systems were built.

- **l.** A third type of obsolescence
  - **(1)** One of an unexpected nature
  - **(2)** Can derail technology decision-making
  - **(3)** And implemented in short order as well
- **m.** This third type pertains to regulators changing the status of a medical device or technology
  - **(1)** Either narrowing the approved scope of use
  - **(2)** Or even recalling the product, after it has been introduced to the market and is generally available

Teaching Tip

Provide the following, for example, one hospital selected an FDA-approved monitoring device and conducted extensive staff training only to have the product recalled three months before its formal deployment. In this case, the completed pre-rollout work was of no use as institutional leaders scrambled to vet a replacement device and reconvene round-the-clock training on the new monitoring technology. Obviously, the rollout was delayed, but considerable time and money were expended for a second time, which created a previously unpredictable drain on cost and staff.

- **n.** While each of these types of obsolescence carries an import all its own
  - **(1)** It is even more critical for nurse executives
  - **(2)** To recognize that the healthcare organization controls none of them
- **o.** In each case, these third-party decisions have enormous impact on when and how nursing uses
  - **(1)** Technology-based products
  - **(2)** Devices
  - **(3)** Systems
- **p.** Additionally, these third-party decisions occur on a timetable over which healthcare organizations have little to no influence
- **q.** Planned obsolescence, shifting environmental mandates from regulators and payers, and changes in regulatory status complicate the already complex landscape of technology-related decision-making
- **r.** What used to be episodic decision-making has morphed the six-stage lifecycle into a technology model with ever-cycling potential

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. Multilayered decision-making
    a. While the lifecycle seems straight-forward
        (1) Its overlay with content, outcomes
        (2) Nursing Informatics and client intervention
        (3) Makes for a complexity not seen in other types of healthcare decision-making
    b. Nursing-centric technology decisions emerge from a context that includes
        (1) Cultural
        (2) Economic
        (3) Social
        (4) Physical requirements
    c. Adding an outcome orientation to those decisions layer on the impacts of
        (1) Cost
        (2) Quality
        (3) Safety
        (4) Satisfaction
    d. Nursing Informatics (NI) staff then views technologies under consideration from the dual perspectives of
        (1) Content structure
        (2) And information flow
    e. Finally, the client factor encompasses
        (1) The site-specific political
        (2) Cultural
        (3) Social aspects of embracing technology
    f. The Informatics Research Organizing model captures the intrinsic complexity of the healthcare-centered technology decision-making process
    g. While the IRO model addresses HIT decision-making from an organizational perspective, a nursing-centric analysis of the process reveals further complexity coming from the dynamics of the physician-dominated HIT discussions
    h. The nursing-centered discussion of HIT decision-making highlights several reasons why medical staff demands often relegate nursing's HIT requirements to a subservient position during technology evaluation and selection

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. Nurse informaticist role
    a. Technologies optimized for the nursing process
        (1) Organize and prioritize patient care data
        (2) Against a complex backdrop of quality and patient safety
    b. Nurse executives' responsibility to evaluate, select, and deploy these advanced technologies requires one of two things
        (1) Either a deep personal and nursing-centric knowledge of technology
        (2) Or access to that knowledge, which is resident in a technology expert
    c. Considering the organizational and interdisciplinary demands on nurse executives
        (1) A direct reporting structure to the technology expert
        (2) Offers the most efficient and effective pathway to this highly specialized knowledge
    d. Often, this direct reporting relationship with the technology-infused individual leads to a Nurse Informaticist (NI)
    e. While some confusion over the preferred background of the graduate-prepared NI exists, nursing experts agree that effective NIs command highly specialized knowledge from three distinct disciplines
        (1) Clinical nursing
        (2) Information technology
        (3) Research
    f. NIs use this rich, interdisciplinary perspective
        (1) To analyze patient care and outcome data
        (2) Creating new knowledge
        (3) That advances the clinical practice of nursing
    g. As a trusted advisor to the nurse executive, the NI serves as a "translator" of
        (1) Technology capabilities
        (2) Options
        (3) Alternatives
    h. Nurse executive looks to the NI to align technologies and systems under consideration with organizational objectives
    i. Even with such an expert on staff, the nurse executive must be able to
        (1) Converse
        (2) Debate
        (3) Champion specific technologies and clinical information systems personally
    j. Simply put, there is no one else at the executive decision-making table with the
        (1) Expertise
        (2) Knowledge
        (3) Or perspective to advance the requirements and needs of patient care during technology-related and discussions and debates

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. Two key areas of expertise
    a. Nurse executives and NIs involved in technology decision-making need to leverage two specific type of IT expertise when they evaluate, select, and implement clinical information systems
        (1) Process mapping
        (2) Workflow design

- **b.** Process mapping delineates the actual steps of clinical practice as they occur during patient care
- **c.** Workflow design spans the mechanical arrangement of
  - **(1)** Information
  - **(2)** Forms
  - **(3)** Triggers to document nursing practice
- **d.** The success of every HIT implementation hinges on
  - **(1)** Having a clear understanding of process mapping and workflow design
  - **(2)** As well as the ability to chart these activities in a format understandable by computers
- **e.** Vendor-resident engineers lack
  - **(1)** The site-specific
  - **(2)** And nursing practice-specific knowledge required to add the context of the lived experience to the workflow creation process
- **f.** Evidence in the standardization of processes and practices is a universal application goal
- **g.** Site-specific modifications are needed to have the software accepted and used by nurses delivering patient care
- **h.** From a nursing perspective
  - **(1)** Leaving this critical foundational work to engineers and technologists
  - **(2)** Who lack the hands-on experience of delivering patient care at the bedside
  - **(3)** Is pure folly
- **i.** Delegating these two key foundational activities to non-nurses resembles the potential disaster created by allowing individual motorists to build their own roads
  - **(1)** With no regard for the needs of their fellow motorists
  - **(2)** And no knowledge of construction, traffic flow, volume, or local weather conditions

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

6. Standardization lacking

- **a.** The importance of process mapping and workflow design in the binary world of computers where options are limited to "yes" or "no"
  - **(1)** Collides head-on
  - **(2)** With the lack of standardization in nursing process, procedure and operation
- **b.** Only the nurse executive or an NI working in concert with the nurse executive can
  - **(1)** Design and implement overarching nursing workflows
  - **(2)** That reflect the organization's nursing process
- **c.** Even in healthcare organizations where these key tasks can be delegated to an NI
  - **(1)** It remains the responsibility of the nurse executive
  - **(2)** That this foundational work be managed and overseen
- **d.** While some aspects of patient care remain resistant to standardization
  - **(1)** The vast majority of these processes can be architected into workflows
  - **(2)** In much the same way that engineering has codified its processes and procedures
- **e.** The criticality of these two elements and their foundational importance
  - **(1)** Make a working knowledge of process mapping and workflow design knowledge
  - **(2)** Essential to nurse executives' evaluation and selection of clinical information systems

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

7. Nurse executives marginalized

- **a.** Nurse executives point to two specific ways they are marginalized in the evaluation and selection of clinical information systems, according to recent research
  - **(1)** Most often, the nurse executives found their review responsibilities limited to the functional level; that is, looking at the systems' features, rather than their ability to advance nursing practice
  - **(2)** Second, nurse executives explained that CMO-led physician contingents regularly dominated IT decision-making, relegating nurse executives to a "specifier/recommender" role
- **b.** As a result, nurse executives found their opportunities to advocate effectively for technology needed to support nursing practice during the evaluation and selection of clinical information systems to be limited
- **c.** With nurse executives relegated to the sideline, no one at the executive decision-making table advocated for the needs of patient care during all-important technology discussions
- **d.** In addition to being marginalized during the technology evaluation and selection process, nurse executives found they lacked technology-related competency despite their advanced degrees
- **e.** Nothing in their traditional business and clinical education prepared them for technology-related decision-making
- **f.** This lack of foundational knowledge, the nurse executives pointed out, hampered their ability to debate the functions of the clinical information systems with their medical staffs
- **g.** What they lacked, the nurse executives said, was the ability to view technology from a strategic and operational perspective
- **h.** That deficiency hampered their adjustment of the systems' standard architectural design, workflow and processes for deployment in their specific patient care environments
- **i.** As a result, nurses, the largest user population in the healthcare organization, often find their technology needs falling in behind physician-championed system requirements

   - **j.** This same research sets out to answer the question, "What is the state of Chief Nurse Executives' HIT-related decision-making as compared to the competencies outlined in AONE's recommended information technology competencies?"
      - **(1)** Participating nurse executives demonstrated competency in and applied the majority of the AONE-outlined capabilities to their decision-making process related to the evaluation, selection, deployment, and utilization of HIT
      - **(2)** However, the majority were not able to demonstrate a competency specific to the AONE's mandate to "demonstrate an awareness of societal and technological trends, issues and new developments as they relate to nursing

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

8. New frontier: Social media
   - **a.** Although the informant nurse executives demonstrated knowledge of technology-fueled innovation in nursing practice, two substantial gaps exist between their knowledge and AONE's stated competency
      - **(1)** Nurse executives' awareness of societal and technological trends, issues and new developments as they relate to the clinical practice of nursing
      - **(2)** Nurse executives' awareness of legal and ethical issues related to client data, information, and confidentiality
   - **b.** It is interesting to note that nurses' use of social media lies at the intersection of these two gaps
   - **c.** In the lived experience, for example, nurses routinely use social media to communicate
      - **(1)** Nurse-to-nurse
      - **(2)** Nurse-to-patient
      - **(3)** Nurse-to-patient, family
      - **(4)** Nurse-to-physician
      - **(5)** Nurse-to-interdisciplinary team
   - **d.** It is troubling that this pervasive communication
      - **(1)** Violates HIPPA regulations
      - **(2)** And occurs with regularity in the majority of facilities, even where nurse executives have "banned" social media

Teaching Tip

Provide the following example, recently, researchers from the University of Florida examined 15 days' worth of anonymous network utilization records for 68 workstations located in the Emergency Department (ED) of an academic medical center, comparing data from the ED workstations to work index data from the hospital's information systems. Throughout the 15-day study period, healthcare workers spent 72.5 hours browsing Facebook, visiting the social networking site 9369 times, and spending 12 minutes per hour on the site. The amount of time spent on Facebook, while significant, was overshadowed by a second research finding: that the hospital workers' time on Facebook actually increased as patient volume in the ED rose. As a result, the researchers recommended future studies look at the impact of restricting Facebook use to break rooms and other nonworking parts of the hospital.

   - **e.** No matter what their "social media use at work" policies say
      - **(1)** Nurse executives cannot claim naiveté when it comes to the use of social media in their organizations
   - **f.** This lived experience does not support nurse executives' beliefs that they have protected the confidentiality of vitally important health information
   - **g.** The use of social media exposes critically sensitive patient data to another vulnerability when personal communications and computing devices, such as
      - **(1)** Smartphones
      - **(2)** Tablets
      - **(3)** Laptops
      - **(4)** And notebooks are backed up via cloud computing
   - **h.** As the lines between communication and computing blur, and as handheld devices gain in power
      - **(1)** More and more personal data
      - **(2)** Are pushed to "the cloud" automatically
   - **i.** Few users of mobile communications and computing segment the information on their devices
      - **(1)** Which means that every piece of data on the device is backed up on the cloud
   - **j.** As a result, sensitive patient data can be duplicated right next to all those
      - **(1)** Family photos
      - **(2)** Recipes
      - **(3)** Blog postings, on the cloud
   - **k.** This backup of the device's data in its totality most often occurs automatically and requires human intervention to be
      - **(1)** Altered
      - **(2)** Partitioned
      - **(3)** Stopped
   - **l.** Potentially breaching the confidentiality and privacy that healthcare organizations work so hard to assure

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

9. Quickening pace of technology adoption
   - **a.** This inability to maintain current knowledge
      - **(1)** Of technical capabilities and the application of those capabilities to the healthcare organization

   (2) Presents a particularly troubling scenario

   (3) When viewed against an emerging trend: the swift pace of technology adoption

b. While considerable debate surrounds the rate at which technical innovation occurs

   (1) With some experts say it is slowing while others point to a quickening

   (2) The adoption of new technologies clearly is picking up speed

Teaching Tip

Provide the following information, consider the pace of "no phone-to-smartphone" adoption. It took 39 years for American's first landline phones to make their way into 40 percent of American households and an additional 15 years for the telephone to become prevalent. That's a total of 54 years. Yet, it took only 10 years for the smartphone to reach the 40 percent penetration rate in 2012. That's why the smartphone has been touted as the most rapidly adopted technology in recorded history.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Summary

- Nurse executives at healthcare organizations of all sizes need help if they are to acquire and maintain current knowledge of HIT
- First, nurse executives need to take seriously their commitment to lifelong learning, especially as it pertains to technology
- Second, nurse executives need to lead the process mapping and workflow design of their HIT systems
- Third, the profession needs to enlist the help of academic leaders and regulators to build a learning infrastructure capable of creating deep HIT competencies for America's executive nurses
- Fourth, this learning infrastructure need not be built "from scratch" as several viable educational options, including but not limited to credentialing organizations and accreditation agencies, such as
    - AONE Certification Center
    - NLN's credentialing center (National League for Nursing)
    - NLN-AC (National League for Nursing Accrediting Commission)
    - ANCC (American Nurses Credentialing Center)
    - CCNE (Commission on Collegiate Nursing Education), already exist
- These centers would be well served to crystallize educational content to address nurse executives' lack of technology knowledge
- Building and maintaining this deep technology competency across the country's ranks of nurse executives will ensure that the "voice of the patient" is heard when these all-important technology decisions are made
- Failing to answer nursing's needs with advanced technologies and systems tailored to their specific clinical environments imperils the quality of patient care as it risks the longevity of nurses and the healthcare organization as well

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Why the technology lifecycle virtually assures perpetual healthcare information technology (HIT) decision-making in healthcare delivery environments
- The need for executive nurses to commit to lifelong learning if they are to participate and actively lead HIT decision-making
- The two most important HIT processes that demand nurse executive involvement
- Where to turn for help in developing and maintaining a nursing-centric, deep HIT competency
- The value that only nurse executives, acting as the all-important "voice of the patient," bring to HIT decision-making

Teaching Tip

Ask the students to define the keywords

- Technology lifecycle
- Process mapping
- Workflow designs
- Nursing-centric HIT expertise
- Voice of the patient
- Nursing Informatics

CHAPTER REVIEW QUESTIONS

Question 17.1: Why does the technology lifecycle assure perpetual healthcare IT decision-making?

a. The complexity of HIT, coupled with the speed of innovation and the rapid adoption of emerging technologies, requires that theoretical and applied knowledge of HIT be up-to-date at all times

b. Because vendors realize that healthcare institutions will always budget for IT

c. Because the regulatory bodies continually change regulations so that industry can respond

d. The complexity of the IT alone causes the long lifecycle

Question 17.2: What type of learning is required for nurse executives if they are to participate in Healthcare IT decision-making?

- **a.** Continuing education required by certification and licensure
- **b.** Lifelong learning to stay abreast of the complex changes occurring
- **c.** Episodic return to formal academic programs
- **d.** Leave of absence to acquire fellowships in IT

Question 17.3: What are two of the most important HIT processes that demand nurse executive involvement?

- **a.** Process mapping and workflow design
- **b.** Commitment to lifelong learning and process mapping
- **c.** Understanding how to negotiate a budget and represent the nursing staff at the executive level
- **d.** Understanding the innovations in HIT and workflow design

Question 17.4: What are the components of the Technology Lifecycle?

- **a.** Procurement and deployment
- **b.** Support, disposition, and planning
- **c.** Project management, account management, and evaluation
- **d.** Management

Question 17.5: What are some ways to maintain nursing-centric deep HIT competency?

- **a.** One must continually review the nursing IT journals and books
- **b.** Belong to membership knowledge synthesizer organizations
- **c.** Keep up with the blogs of nursing informaticists
- **d.** Credential nurses through such credentialing organizations and accreditation agencies, such as AONE Certification Center, NLN's credentialing center (National League for Nursing), NLN-AC (National League for Nursing Accrediting Commission), ANCC (American Nurses Credentialing Center), and CCNE (Commission on Collegiate Nursing Education)

Question 17.6: Who is the effective "voice of the patient?"

- **a.** Doctors are the patient's voice
- **b.** The nurse executives will ensure that the "voice of the patient" is heard
- **c.** Patient advocacy groups will assure the "voice of the patient" is heard
- **d.** Social works provide the "voice of the patient" in most healthcare environments

Question 17.7: How can academic leaders and regulators ensure nurse executives have competencies in HIT?

- **a.** The profession needs to enlist the help of academic leaders and regulators to build a learning infrastructure capable of creating deep HIT competencies for America's executive nurses
- **b.** They have no role with nurse executives
- **c.** Academic leaders and regulators have missions that are outside the scope of helping executive nurses
- **d.** The academic leaders have a sole responsibility to the students who enroll in their classes.

Question 17.8: What are two gaps identified by AONE in the nurse executives?

- **a.** How to map workflow and process mapping to IT needs
- **b.** Conducting a technical and functional requirements analysis for their IT needs
- **c.** Nurse executives' awareness of societal and technological trends, issues and new developments as they relate to the clinical practice of nursing; and their awareness of legal and ethical issues related to client data, information, and confidentiality
- **d.** Understanding the role they can have in the patient voice and the nurse's voice

Question 17.9: Why are nurses valued members of a vendor assessment and implementation team?

- **a.** Vendor-resident engineers lack the site-specific and nursing practice-specific knowledge required to add the context of the lived experience to the workflow creation process
- **b.** Nurses are used to multidisciplinary teams and conflict management
- **c.** The nurse is usually training in Informatics and Engineering
- **d.** The nurse is usually the most expendable person on the team

Question 17.10: What are two activities that the nurse must be involved with in a HIT team?

- **a.** Understanding workflow and standards
- **b.** Training and scheduling nurses
- **c.** Training, scheduling, and communicating with nurses
- **d.** Identifying patient preferences and establishing a patient portal to the Internet

ANSWERS AND EXPLANATIONS

Question 17.1: (a) The complexity of HIT, coupled with the speed of innovation and the rapid adoption of emerging technologies, require that theoretical and applied knowledge of HIT be up-to-date at all times.

Question 17.2: (b) First, nurse executives need to take seriously their commitment to lifelong learning, especially as it pertains to technology.

Question 17.3: (a) Process mapping delineates the actual steps of clinical practice as they occur during patient care, while workflow design spans the mechanical arrangement of information, forms and triggers to document nursing practice.

Question 17.4: (c) The Technology Lifecycle includes procurement, deployment, support, disposition, planning, and management. It does not include project management, account management, and evaluation.

Question 17.5: (d) Credential nurses through such organizations that credential including: AONE Certification Center, NLN's credentialing center (National League for Nursing), NLN-AC (National League for Nursing Accrediting Commission), ANCC (American Nurses Credentialing Center), and CCNE (Commission on Collegiate Nursing Education).

Question 17.6: (b) The nurse executives will ensure that the "voice of the patient" is heard

Question 17.7: (a) The profession needs to enlist the help of academic leaders and regulators to build a learning infrastructure capable of creating deep HIT competencies for America's executive nurses.

Question 17.8: (c) Nurse executives' awareness of societal and technological trends, issues and new developments as they relate to the clinical practice of nursing; and their awareness of legal and ethical issues related to client data, information, and confidentiality.

Question 17.9: (a) Vendor-resident engineers lack the site-specific and nursing practice-specific knowledge required to add the context of the lived experience to the workflow creation process.

Question 17.10: (a) Understanding workflow and standards are two of the most important activities nurses bring to the engineering team.

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Establishing Nursing Informatics in Public Policy

• OBJECTIVES

1. Examine the course to navigate public policy as related to healthcare and nursing informatics.
2. Define the public policy process.
3. Analyze the skills and competencies nursing informaticists must possess in order to effectively communicate with policy makers and those in positions to sway policy makers.
4. Explore how nursing informaticists are impacting public healthcare policy.
5. Review how education for nurses continues to increasingly leverage technology for learning and supporting nursing practice.
6. Encourage the nursing profession to collaborate, educate, and coordinate efforts in policy formulation to support nursing's roles in quality, safety, and patient advocacy.

• KEY WORDS

Accountable care
Healthcare informatics
Healthcare reform
Health information technology
Nursing informatics
Public health policy
Public healthcare policy
Public policy

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Why is important for nurses to be informed about public policy related to healthcare? What are current legislations related to healthcare and health information technology? What resources could be used to learn about healthcare legislation? Is it important for nurses to have a voice in public policy? How could nurses make their voice known regarding public policy?

For a WIIFM statement, say to the class, "This chapter explores the various components of public policy impacting healthcare, health IT, and NI. It provides a highlight of legislative initiatives, the public policy process and avenues for engagement of and influence by NI. This chapter also presents considerations relating to healthcare reform now and in the future, including bridging settings of care for healthier individuals, communities, and population health; and engaging the patient and family toward better health. This chapter includes a call to collaboration and opportunities for the NI community to engage with public and private stakeholders. As a nurse, it is important to understand the components of public policy impacting healthcare and the influence on health information technology and nursing informatics.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit relevant Internet Web sites

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
    a. ***Nursing informatics leaders should be engaged in all levels of health IT policy and strategy-setting committees and initiatives.*** *HIMSS Position Paper: Transforming Nursing Practice through Technology & Informatics*
    b. Understanding the public policy process and avenues for influence can assist
        (1) Nursing informatics in engaging and influencing public healthcare policy
        (2) To improve healthcare delivery and quality patient care
    c. Although nursing informatics (NI) has had a role in shaping public health information Technology (IT) policy
        (1) It must continue to be engaged in shaping public healthcare policy
    d. In this era of the US Health Information Technology for Economic and Clinical Health (HITECH) Act, and the Patient Protection and Affordable Care Act (PPACA)
        (1) It is especially critical for the NI community to understand public healthcare policy drivers
        (2) And how to deliver a unified message to those who create public healthcare policy
        (3) This will not happen by chance; carefully crafted strategy and collaboration needs to occur now
    e. Those who will lead the efforts to ensure that NI public policy issues are heard require education, competencies, avenues for collaboration, and support

Teaching Tip

Provide this information if not provided in the WIIFM or reinforce, this chapter explores various components of public policy impacting healthcare, health IT, and NI. It provides a highlight of legislative initiatives, the public policy process and avenues for engagement of and influence by NI. This chapter also presents considerations relating to healthcare reform now and in the future including bridging settings of care for healthier individuals, communities, and population health, and engaging the patient and family toward better health. This chapter includes a call to collaboration and opportunities for the NI community to engage with public and private stakeholders.

Navigating the Course in Public Policy to Impact Healthcare

1. Overview
    a. Nearly every aspect of the healthcare system including
        (1) Finance and reimbursement
        (2) Education
        (3) Facilities, products, and services
        (4) Professional practice and workforce capacity
        (5) And technology, including health IT, are influenced by public policy
    b. It is vital that the NI community understand and acquire skills to
        (1) Navigate the public policy process to ensure that the nurses' voices
        (2) And their critical positions on healthcare and health IT are heard
        (3) This includes understanding the policy process as well as politics
    c. With an expected 33 million additional Americans to have access to healthcare under PPACA
        (1) Along with initiatives like Medical Homes and Accountable Care Organizations (ACO)
        (2) PPACA will have significant impact on our healthcare providers
        (3) Including nursing's role in providing care
    d. Primary care provider shortfalls may increase up to 46,000 by 2020
        (1) As well as current undersupply of 7550 physicians in primary care Health Professional Shortage Areas (HPSAs)
        (2) In addition, by 2020 there is an expected overall physician shortage of over 90,000 and shortage of primary care physicians of over 45,000
        (3) Positioned to fill some of this need, Nurse Practitioners (NP) and Physician Assistants (PA) are the fastest growing provider segments in primary care
    e. Another critical public policy and health interface was the passage of the HITECH Act
        (1) As part of the American Recovery and Reinvestment Act (ARRA) of 2009
        (2) This legislation was a culmination of various efforts over the years to recognize and facilitate the adoption of health IT throughout the United States
        (3) The HITECH Act included significant incentives for acute care eligible hospitals, critical access hospitals (CAHs), and eligible providers (EP) to acquire and implement electronic health records (EHR) and supporting technology
        (4) Also known as the Medicare and Medicaid EHR Incentive Programs, it provides incentive payments to adopt, implement, upgrade, or demonstrate "meaningful use" (MU) of certified EHR technology
    f. Since the passage of HITECH
        (1) Hospital and provider implementation and use of EHR technology has dramatically increased
        (2) Hospitals' meeting MU objectives grew significantly, with increases ranging from 32 to 167 percent
        (3) Since HITECH started, physician adoption of EHR technology meeting MU objectives has increased from 66 to 97 percent

g. In addition, since the passage of HITECH
  (1) Four in five NPs in the United States are enrolled with an Regional Extension Center (REC) and are live with an EHR
  (2) Operating at the top of their license, NPs and PAs offer treatment, patient education, and care coordination
  (3) These providers are fundamental to broad expansions of healthcare and payment reforms facilitated by MU of health IT, electronic health records (EHR), and health information exchange (HIE)

h. However, it is worth noting while health reform is providing expanded opportunities for NPs
  (1) There remain restrictions on practice autonomy by many states
  (2) And NPs that do practice with independent authority are not eligible to participate in the EHR Eligible Provider incentive for Medicare
  (3) According to CMS, to address this oversight in the Medicare MU program to include NPs with independent authority for the Medicare Eligible Provider program would require a congressional legislative modification
  (4) Hopefully, with nursing public policy advocacy, this change will occur in the near-term future

i. The extent to which nurses contribute to policy development, including the PPACA, is nearly impossible to comprehend
  (1) The American Nurses Association (ANA) created *Healthcare Reform: Key Provisions Related to Nursing* and the American Association of Colleges of Nursing (AACN) created *Patient Protection and Affordable Care Act,* which provides charts outlining how the law supports continued nurse education and all sectors of the nursing workforce
  (2) These charts also explain how PPACA addresses the nursing shortage (especially as related to skilled nursing), quality improvement, best practices, and public health initiatives
  (3) While impressive, nursing's participation to engineer these changes is only one aspect of the role played in creating PPACA
  (4) And nurses are involved in numerous other initiatives related to improving the quality and delivery of care

j. Legislative initiatives create opportunities for nurses to help shape policies
  (1) That will drive the implementation of technology to support
  (2) A cost effective, accessible, patient centered and continuity of care model
  (3) To improve health outcomes in our country
  (4) And the increasingly important role of nurses in the creation and execution of public health policy cannot be overlooked

k. Collaboration at the public healthcare policy level
  (1) Impacts the future of nursing and care delivery
  (2) While setting expectations for standards of care
  (3) That nurses are responsible for advancing at the most salient level
  (4) With over 3.1 million nurses in the United States alone, nurses are the apparatus for implementation of public healthcare policy

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. Exploring the public policy process and NI influence

Teaching Tip
Provide this information, this section focuses on navigating the public policy path particularly how it impacts public healthcare policy, health IT, and NI. Understanding and exploring ways to navigate various aspects of the public policy process and identifying avenues for impact in order to influence changes in healthcare delivery, partly through the use of technology, is an essential skill set for nurse informaticists.

a. *Public policy* is the action taken by government to address a particular public issue
  (1) Local, state, federal, and international government organizations all craft and implement public policy to protect and benefit their populations

b. *Health policy* refers to decisions, plans, and actions that are undertaken to achieve specific health care goals within a society
  (1) An explicit health policy can achieve several things: it defines a vision for the future, which in turn helps to establish targets and points of reference for the short and medium term
  (2) It outlines priorities and the expected roles of different groups; and it builds consensus and informs people
  (3) Health policy is a course of action that influences healthcare decisions

c. During the Institute of Medicine's (IOM's) Forum on the Future of Nursing, Selecky noted, "Public health cannot be separated from politics … as demonstrated by the term 'public'"
  (1) Nurses have led public health initiatives throughout the United States and beyond that are widely recognized as unquestionable successes
  (2) These initiatives include vaccination campaigns, AIDS prevention and awareness, infection control, and disaster response mobilization

d. *Public healthcare policy* is that piece of health policy that deals with the organization, financing, and delivery of healthcare services
  (1) This includes training of health professionals, overseeing the safety of drugs and medical devices, administering public programs like Medicare and regulating private health insurance

- **(2)** The obligation of government to promote and protect the public's health is grounded in the US Constitution
- **(3)** Connected to all of this is a myriad of details concerning the licensing of health professionals and facilities, health information privacy protections, measures of healthcare quality and mistakes, malpractice, electronic medical records, and efforts to control healthcare costs

Teaching Tip
Refer to Figure 18.1 which provides an illustration of these various public policy components.

So how do the ideas that originated at the grassroots, clinical practice level make it through the public policy process and become laws?

e. While the exact process varies from state to state and from state to national levels
- **(1)** If the right people and organizations have been engaged, the nursing informaticist's recommended best practices are sponsored by a legislator and introduced in a bill
- **(2)** From here, the bill goes to committee and experts from various groups that the committee anticipates will be impacted by the bill are asked to provide their reasons for supporting or opposing the bill
- **(3)** The committee may also seek recommendations for modification
- **(4)** Eventually, this bill goes to the floor where the House will vote on whether to approve it
- **(5)** If the bill isn't passed, it will either be dropped, sent back to the committee for modification, or sit for a time before it is reintroduced
- **(6)** If and when the bill is passed in one House, the bill is sent to the other House where this process is repeated
- **(7)** This is why it is ideal to have both chambers introduce the same bill, known as a companion bill
- **(8)** When both Houses agree on a bill, it is sent to the highest-ranking official (i.e., Governor or President)
- **(9)** The President or Governor then either signs the bill into law or employs veto power to prohibit passage of the bill
- **(10)** If the bill is vetoed, it needs to be reintroduced in one of the Houses before any law-making activities resume

f. While this process may read easily on paper
- **(1)** There are many factors that impact a federal bill's viability in Congress

Teaching Tip
Provide the following examples, such as the number of Congressional cosponsors supporting the bill, the level of support from constituents and national organizations, and the current political agenda.

- **(2)** On average, it can take seven to eight years for legislation to pass if it is not on the national agenda
- **(3)** Although there are no guarantees, some bills based on the national agenda are never even reported out of committee
- **(4)** For these reasons, it is important that nurses understand the politics and policy of the issues they are working with to create change
- **(5)** They must work closely with experts in the field, in addition to political strategy and advocacy experts, to move an issue forward

Teaching Tip
Refer to Figure 2 which provides a simplified graphic outlining how a bill becomes a law.

g. Examples of public healthcare policy include federal legislation, such as HITECH and PPACA
- **(1)** These public healthcare policies have produced a significant increase in healthcare technology adoption
- **(2)** As well as new models for healthcare access, reimbursement, and delivery

h. The goals of these national healthcare policies include improving access, quality and safety, and reducing costs of healthcare
- **(1)** The National Quality Strategy (NQS), called for under the PPACA, created national aims and priorities to guide local, state, and national efforts to improve the quality of healthcare in the United States
- **(2)** The NQS noted three aims ("Triple Aims") for the healthcare system, including Better Care, Healthy People and Communities, and Affordable Care
- **(3)** These are the goals to which NI should aspire
- **(4)** Being engaged in the national conversation regarding the use of technology and information to improve care and health of our patients while reducing costs is a natural role for NI

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. Avenues for influencing policy

Teaching Tip
Provide the following information, in addition to the legislative levers, nurse informaticists should understand the roles of and consider participating in other policy development efforts such as advisory committees, policy institutes, professional organizations, technical expert panels (TEPs), and NI policy advocates.

a. Federal advisory committees
- **(1)** Three important healthcare and health IT related federal advisory committees
- **(2)** The National Committee on Vital and Health Statistics (NCVHS, 2013) established in 1949

by Congress to serve as an advisory body to the Department of Health and Human Services (HHS) on health data, statistics, and national health information policy

- **(3)** The Health Information Technology Policy Committee (HITPC)
- **(4)** The Health Information Technology Standards Committee (HITSC) established through ARRA for developing policy recommendation to the National Coordinator for Health IT
- **(5)** These three committees operate under the rules established by the Federal Advisory Committee Act (FACA)
- **(6)** The FACA defines *advisory committee* as "any committee, board, commission, council, conference, panel, task force, or other similar group" that dispenses "advice or recommendations" to the President of the United States, and excludes bodies that also exercise operational functions

b. Policy institutes

- **(1)** A policy institute (often termed "think tank" by journalists) is an organization that performs research and advocacy concerning topics such as social policy, political strategy, economics, military, technology, and culture
- **(2)** There are numerous institutes that conduct research and analysis; develop white papers and policy positions; and provide recommendations specifically on healthcare related topics, but a prominent voice in healthcare thought leadership is the IOM

c. Professional organizations

- **(1)** Another important avenue for influencing health IT and informatics policy is engagement with professional associations
- **(2)** The ANA and AACN, both actively engaged in healthcare policy issues and deliberations
- **(3)** Also initially a subsidiary of the ANA and now a nonprofit corporation, the American Academy of Nursing (AAN) serves the public and the nursing profession by advancing health policy and practice through the generation, synthesis, and dissemination of nursing knowledge
- **(4)** The Academy and its member Fellows create and execute knowledge-driving and policy-related initiates to drive reform of America's healthcare system
- **(5)** In 2013, the Academy released the report, "The Importance of Health Information Technology in Care Coordination and Transitional Care"
- **(6)** Based upon the premise that care coordination and transitional care services are strategically important for achieving the NQS Triple AIM, the AAN believes that HIT is essential to enable care and communication across communities of care to include the patient and family
- **(7)** This report "offers a set of recommendations to guide the development of the infrastructure, standards, content and measures for electronically enabled care coordination and transitions in care as well as research needed to build the evidence base to assess outcomes of the associate interventions"
- **(8)** Another professional organization involved in health IT and NI policy deliberations and active contributor to policy comments is the Alliance for Nursing Informatics (ANI)
- **(9)** The ANI, in coordination with the American Medical Informatics Association (AMIA) and the Healthcare Information and Management Systems Society (HIMSS), is a collaboration that represents multiple nursing informatics organizations, and responds as one voice to federal health policy initiatives by sharing nursing informatics perspectives for shaping health policy
- **(10)** The ANI enables a unified voice for the NI community to engage in issues in the public healthcare policy process; information technology standards; information systems design, implementation and evaluation; and shared communication and networking opportunities
- **(11)** Another professional organization involved in emerging health technologies is the American Telemedicine Association (ATA) which brings together diverse groups, including nursing associations, for the advancement of telemedicine in healthcare delivery
- **(12)** In January 2014, ATA released draft *ATA Core Guidelines for Telemedicine Operations* to assist practitioners to provide effective and safe medical care
- **(13)** The draft guidelines recognize that safe and effective practice requires specific training, skills, and techniques for telemedicine
- **(14)** Professional organizations like AMIA and HIMSS can legitimize claims made by those in NI leadership positions by accepting their recommendations
- **(15)** These organizations network with other professional organizations, as well as professional lobbyists, to promote the causes of nursing informatics and effective care delivery
- **(16)** The AMIA Nursing Informatics Working Group (NIWG) and the Public Policy Committee have continued to influence healthcare public policy and HIT policy
- **(17)** In coordination with its members, AMIA works with key decision-makers, policy-makers, and other health stakeholders to help shape public policies that effectively address today's ongoing biomedical and health informatics issues
- **(18)** HIMSS is a global, cause based organization with a national Government Relations office and engaged NI Community that frames and leads healthcare practices and public policy through its content expertise, professional development, and research initiatives
- **(19)** HIMSS impacts health policy through a variety of avenues, including direct legislative outreach, participation in public comments, guidance documents, position statements, and professional tool boxes
- **(20)** Leveraging and incorporating the NI expertise in position papers and deliberations is an important aspect of ensuring the NI voice is heard in policy debates

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

- **d. Technical experts panels**
  - **(1)** Another avenue for influencing policy are TEPs
  - **(2)** A TEP is a group of stakeholders and experts who provide technical input in areas that an organization or may be in need of for a broader perspective on a topic
  - **(3)** Specific tools and meetings may be employed to select and engage the panel, assign tasks and elicit sharing and further development of knowledge
  - **(4)** Many federal and national organizations use TEPs such as CMS, ONC, Agency for Healthcare Quality and Research (AHRQ), and the National Quality Forum (NQF)

Teaching Tip
Provide the following example, an example of a TEP involved in healthcare informatics is CMS's Quality Measures TEP. This TEP provides technical input to the measure contractor on the development, selection, and maintenance of measures for which CMS contractors are responsible. TEP members are chosen to provide input to the measure contractor based on their personal experience and training. TEP members are selected to represent a diversity of perspectives and backgrounds. Information on the nomination process, including self-nominations are available on the CMS public website.

- **e. NI policy advocates**
  - **(1)** In addition to the organizations listed above, knowledgeable policy nursing informaticists work in a variety of settings where policy issues are addressed, such as academia, vendor, consulting and advisory firms and within government agencies that drive public policy
  - **(2)** Related to federal agencies that are driving the formation of specific policies are the nursing informaticists that work inside agencies such as CMS, ONC, AHRQ, NIH, and others
  - **(3)** Another aspect to a key strategy of influencing public policy is strengthening relationships and informing this nursing stakeholder group about the issues, challenges, needs, and gaps
  - **(4)** And once again, employing bi-directional communication to provide opportunity to hear their perspectives and how they can be better supported in their efforts that may influence public policy as well
  - **(5)** Increasing nursing informaticists awareness of various avenues for engagement and understanding of how to get involved in the public policy process will help ensure that the nursing voice is heard
  - **(6)** Building the skills, competencies, and confidence to engage is part of the critical path to influence public policy

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

How Do Nursing Informaticists Influence Public Policy?

1. **Nursing informatics shaping the future of healthcare**
   - **a.** The IOM has released several landmark reports that serve as a continued gateway for nursing informatics to shape the future of healthcare
   - **b.** Three reports of particular relevance are
     - **(1)** Future of Nursing Leading Change, Advancing Health
     - **(2)** Health IT and Patient Safety
     - **(3)** Best Care at Lower Cost … The Path to Continuous Learning Healthcare in America

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. **Future of Nursing report**
   - **a.** The Future of Nursing report is not only about nursing, but the future of healthcare in the United States
   - **b.** The report outlines nursing as a key factor to successfully achieving improved outcomes, optimal wellness, and overall population health management
   - **c.** Because of the breadth and depth of nursing engagement in all aspects of healthcare, nurses are in a key position to influence healthcare reform and the multidimensional needs across all care settings
   - **d.** TIGER (Technology Informatics Guiding Education Reform) provided testimony to the Future of Nursing (FON) committee about the important role of healthcare informatics in creating a vision for nursing, "This is an opportunity to integrate informatics within nursing education, practice, and research so nurses are armed with the necessary tools to address 21st-century clinical practice, in an effective, efficient, and safe manner, while also holding the highest standards of evidence-based practice"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. Health IT and patient safety
   - **a.** The IOM Health IT and Patient Safety Report summarizes existing knowledge of the effects of health IT on patient safety and made recommendations to maximize and promote safety of health IT assisted care
   - **b.** Findings included
     - **(1)** Health IT can improve patient safety even though the gaps in potential risks of health IT are not fully understood

  - **(2)** Health IT needs to be viewed as part of the larger sociotechnical system
  - **(3)** All stakeholders need to work together for a coordinated effort to identify and understand patient safety risks associated with health IT
- **c.** Who better than nursing informatics should engage and lead in efforts to identify and understand patient safety risks associated with health IT
- **d.** Nursing informaticists are also in prime position to participate in research and the development of standards and criteria for safe design, implementation, and use of Health IT
- **e.** The ONC was charged with developing an action plan to address the recommendations and released the action plan in mid-2013 after consideration of public comment to include input from nursing informaticists and NI organizations

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. Best care at lower cost…The path to continuous learning healthcare in America
- **a.** *Best Care at Lower Cost* defines the foundational characteristics of a healthcare system that is efficient, delivers increased value, and is continuously innovating and improving in its ability to deliver high value to patients
- **b.** The reports outline several recommendations to include
  - **(1)** The need for a digital infrastructure that supports the capacity to capture clinical, delivery process, and financial data for better care, system improvement, and creating new knowledge
  - **(2)** The need to improve data utility by streamlining and revising research regulations to improve care, promote the capture of clinical data, and generate knowledge
- **c.** Applying these new strategies can support the transition to a continuously learning health system, one that aligns science and informatics, patient-clinician partnerships, incentives, and a culture of continuous improvement to produce the best care at lower cost
- **d.** This IOM report's findings and recommendations clearly outline opportunity for Nursing Informatics
  - **(1)** To engage and lead in policy and research aspects
  - **(2)** To create the right infrastructures to capture clinical and financial data
  - **(3)** Aligning with the delivery process to provide better care, system improvement, and creating new knowledge
- **e.** The focus on
  - **(1)** Technical and practice standards
  - **(2)** As well as analytics strategy
  - **(3)** Will ultimately support organizations' drives toward accountable care and achievement of the goals and priorities of the NQS
- **f.** These IOM report recommendations and execution of recommendations provide for many opportunities for nursing informatics to
  - **(1)** Influence future policy
  - **(2)** And shape the healthcare landscape
- **g.** Collaborative efforts among several nursing related organizations are underway to unify the voice and efforts
- **h.** Some of these organizations have been outlined in this chapter

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. Position statement: Transforming nursing practice through technology and informatics
- **a.** The IOM Future of Nursing report has stimulated and accelerated efforts among nursing organizations to collaborate and unite on behalf of nursing and future care delivery in the United States
- **b.** In alignment with the ANA and the ANI, the HIMSS Position Statement, "Transforming Nursing Practice Through Technology and Informatics"
  - **(1)** Provides background on key related issues
  - **(2)** And identifies specific recommendations for eliminating barriers and addressing nursing's role in transforming healthcare through the use of IT
  - **(3)** Particularly in regard to the role of nursing informatics
- **c.** This statement was developed by the HIMSS Nursing Informatics Committee
  - **(1)** Representing now more than 6500 nurse informaticists
  - **(2)** And is supported by HIMSS at large
  - **(3)** Collaboration and unified messaging among all stakeholders are keys to success
  - **(4)** "We (HIMSS) believe that nurses and nursing informatics specialists are vital to accomplishing the goals described in this position paper and advancing healthcare transformation through the use of health IT"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

6. Emerging NI roles and call to action
- **a.** NI roles
  - **(1)** Continue to evolve, expand, and emerge
  - **(2)** And are critical to engage in the necessary transformation activities
  - **(3)** And bridge the new care delivery models into clinical practice with the right technology solutions

- **b.** In order to participate in the public policy process, NI Leaders must be knowledgeable and current in public policy and regulatory initiatives
- **c.** They must
  - **(1)** Be able to translate the impact of these changes in practice and care delivery
  - **(2)** While having a voice in planning, implementation, and execution to achieve the requirements of the industry changes
- **d.** Nursing Informaticists increasingly have the opportunity to influence and shape public policy
- **e.** Meaningful Use and the technology agenda at large while focused on supporting the achievement of the NQS will not be accomplished without all nurses
- **f.** All nurses have a role to unlock the barrier doors that exist today for the necessary changes to achieve the "One voice, One vision" of healthcare transformation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Workforce Implications

1. Overview
- **a.** While PPACA takes no action to expressly support or fund nursing informatics, it does include provisions for preparing the workforce for the 21st century
- **b.** Achieving the goals of the Healthcare Reform Bill that relate to health IT would be difficult, or even impossible, if NI is not included as part of the equation
- **c.** Opportunities for improving awareness of informatics, enhancing Health IT skill levels, and better positioning NI within healthcare policy continue to grow on many different level
- **d.** To assuage any doubt about the expanding influence of NI in the healthcare arena
  - **(1)** The provisions of the HITECH Act created a demand for new and highly skilled employees
- **e.** Recognizing that healthcare already suffers from a nursing shortage exacerbated by a lack of qualified faculty
  - **(1)** The ONC was funding for training programs for HIT
  - **(2)** Including funding for informatics programs
- **f.** While informatics programs continue to increase in size and curriculum development
  - **(1)** Supplying the demand for qualified nursing informaticist is not fully met
- **g.** Preparing the workforce for the 21st century is key and will include an ever increasing focus on
  - **(1)** Education
  - **(2)** And usability of technology
- **h.** Nursing Informatics leaders will need to lead by
  - **(1)** Establishing the strategy and plan for their respective organizations
  - **(2)** So technology becomes a natural interwoven aspect of care delivery and workflow
- **i.** Academia and research settings must be included as well
  - **(1)** To not only train the future workforce
  - **(2)** But to support innovations in nursing practice leveraging research-based evidence
- **j.** NI leader roles are in prime position
  - **(1)** To bridge research, education, and practice settings
  - **(2)** To achieve innovations for nursing practice
  - **(3)** And prepare the workforce for the future

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. Skills and competencies nursing informaticists need to effectively communicate with policy makers and influencers
- **a.** Advocating for informatics is a complex responsibility that requires in-depth knowledge of both clinical processes and clinical systems
- **b.** The informatics nurse is advocating not only on behalf of patients, but also on behalf of all nurses and caregivers, as well as known and anticipated technological capabilities
- **c.** The informatics nurse must recognize and be able to articulate issues of
  - **(1)** Usability
  - **(2)** Interoperability
  - **(3)** Standardization
  - **(4)** Terminology
  - **(5)** Cost
  - **(6)** Quality
  - **(7)** And safety
- **d.** Informatics nurses must be
  - **(1)** Strategists
  - **(2)** Leaders
  - **(3)** Effective communicators
  - **(4)** They must engage stakeholders across multiple spectrums to ensure patient, nursing, and technological needs are understood and met
- **e.** This includes creating buy-in from
  - **(1)** Managers, administrators, and IT within the organization
  - **(2)** As well as consultants, developers, and implementation specialists
- **f.** It further includes those who may be outside the clinical setting
  - **(1)** Like investors and policy makers
  - **(2)** Whose decisions can have a huge impact on clinical systems and processes

Teaching Tip
Provide this example, according to Suzanne Begeny, Director of Government Affairs at the American Association of the Colleges of Nursing, "In order to effectively shape public policy, nurses need to realize that it takes a significant financial investment to compete on the national level. In addition to money, nurses must act as the impetus for the message, orchestrate support, and prepare our leaders for the political stage." In this way, nursing informatics issues will gain the recognition necessary to be taken seriously as healthcare reform progresses.

g. Nursing informaticists must be able to convey their concerns about
  (1) Data, and its availability for reporting and dissemination
  (2) In terms that are easily understood within the context of the recipient's own constitutional paragon
h. Nursing informaticists must engage key stakeholders at the intersection of the stakeholder's ability and willingness to influence change
i. There are many ways to ascertain this understanding
  (1) Participation in task forces, summits, conferences
  (2) Creation of white papers
  (3) Lobbying and support of lobbying efforts
  (4) Membership in relevant organizations
  (5) Acting as an expert witness
  (6) Leading selection committees
j. With so many options, it is also necessary that NI leaders are strategic when determining who to engage and with whom to collaborate
k. They must
  (1) Learn to read others' willingness to assume a shared responsibility for quality informatics
  (2) And speak to them in a manner that causes these key players to want to take up the cause
l. NI leaders must learn to recognize
  (1) Appropriate engagements
  (2) Terms of engagement—even when it comes to their own involvement in promoting a particular cause
m. Gaining alignment and voice with professional organizations such as
  (1) HIMSS, AMIA, ANI, ANA, and others
  (2) Creates the power to influence and shape policy that often cannot be achieved as a single individual and/or smaller representation
n. Not to minimize grassroots efforts
  (1) But important to know when to expand grassroots to the next level
  (2) Where organizations typically have more formal venues and channels of influence

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. Considerations for public health, LTPAC, home health, rural, school and community health settings and patient engagement
  a. Both the ARRA of 2009 and the PPACA of 2010 are transformative pieces of health legislation that aim to
    (1) Stimulate EHR adoption throughout the acute care and physician practice sectors
    (2) For greater efficiency, patient safety, and improved quality
    (3) With better coordination of care across providers, venues, and geographies
  b. New clinical care delivery strategies and programs are called for that will create accountable care and managing the health of populations
  c. The new models of care must
    (1) Address and mitigate the fragmentation and waste in our siloed healthcare systems
    (2) While increasing accountability by care delivery team members and patients
  d. These new models and initiatives must also allow for an expanded resource capacity to accommodate the healthcare needs that will be coming from the
    (1) Rapid growth in our elderly population
    (2) And the increasing populations with chronic diseases
  e. Care settings such as long-term care, post-acute, community-based and school-based settings have all too often been left behind and excluded in the patient's longitudinal plan of care
  f. Better health, healthier communities, access and decreased costs will not be achieved without inclusion of these settings
  g. With the rise of ACOs and Population Health management, improved coordination of care and communication that spans the care continuum is necessary
  h. These new models also require an expanding technology infrastructure supported by health analytics that combines clinical, financial, and operational data
  i. Nursing informatics is needed to
    (1) Engage and lead in defining the necessary technologies and analytics to support future care delivery
    (2) And the management of individuals and populations health

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Healthcare Reform

1. Outline
  a. New healthcare delivery and payment models, such as Medical Homes and ACOs
    (1) Driven by healthcare reform
    (2) Will require an innovative look at how patient and consumer information is captured, exchanged, analyzed, and acted upon

- **b.** The medical home is a model for achieving primary care excellence so that care is
    - **(1)** Received in the right place
    - **(2)** At the right time
    - **(3)** And in the manner that best suits a patient's needs
- **c.** Accountable Care Organizations (ACOs)
    - **(1)** Are groups of doctors, hospitals, and other health care providers
    - **(2)** Who come together to provide coordinated high quality care to a defined group of patients
- **d.** The goal of coordinated care is to ensure that patients, especially the chronically ill,
    - **(1)** Get the right care at the right time
    - **(2)** While avoiding unnecessary duplication of services and preventing medical errors
- **e.** NI leaders are needed to engage in ACO strategy development, implementation, and execution
- **f.** It will be critical for NI leaders to "lead" change management
    - **(1)** To shape behavior and thinking from current models today
    - **(2)** Which are often physician and/or acute care centric
    - **(3)** To a cross-continuum coordinated care approach that involves all appropriate care team members
- **g.** NI leaders are essential stakeholders
    - **(1)** To orchestrate what information must be provided, captured, and documented to support patient care
    - **(2)** And the associated financial and business indicators to monitor and report on outcomes management as well
- **h.** Technology will continue to be a fundamental enabler to the future care delivery models
- **i.** NI leaders will be essential to lead the way and to innovate nursing practice through technology

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- Nurse Informaticists must recognize the importance of engaging in the public policy process and advocating for advancements in technology and processes that will promote improved patient care, better health, and lower healthcare costs in the United States
- We must take leadership seats at the decision-making table
- We must strategically collaborate and plan to have a voice; we must not give away our advocacy voice
- The formation of good public health policy relies on quality, unbiased, substantial data as well as the expertise of those who provide care within the healthcare environment
- We need to lead the charge and engage leadership on every necessary level to ensure that public policy supports NI initiatives
- No one is better positioned to collaborate with technology vendors, regulatory bodies, politicians and others to ensure that healthcare technologies and public policies promote patient care at the extraordinary level we have always ascribed to in nursing

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Examine the course to navigate public policy as related to healthcare and nursing informatics
- Define the public policy process
- Analyze the skills and competencies nursing informaticists must possess in order to effectively communicate with policy makers and those in positions to sway policy makers
- Explore how nursing informaticists are impacting public healthcare policy
- Review how education for nurses continues to increasingly leverage technology for learning and supporting nursing practice
- Encourage the nursing profession to collaborate, educate, and coordinate efforts in policy formulation to support nursing's roles in quality, safety, and patient advocacy

Teaching Tip
Ask the students to define the keywords

- Accountable care
- Healthcare informatics
- Healthcare reform
- Health information technology
- Nursing informatics
- Public health policy
- Public healthcare policy
- Public policy

CHAPTER REVIEW QUESTIONS

Question 18.1: Public policy is defined as ____________________?

- **a.** Public policy is the action taken by government to address a particular public issue
- **b.** Public policy is the action taken by the federal government only to address a particular public issue

c. Public policy is the action taken by state governments only to address a particular public issue

d. Public policy refers to decisions, plans, and actions that are undertaken to achieve specific healthcare goals within a society

Question 18.2: The formation of good public policy relies on what data?

a. The formation of good public health policy relies on position papers developed by students

b. The formation of good public health policy relies on quality, unbiased, substantial data as well as the expertise of those who provide care within the healthcare environment

c. The formation of good public health policy relies on congressional aides who work with the Congress and Senate

d. The formation of good public health policy relies on all of the above

Question 18.3: What must NI Leaders know in order to participate in the public policy process?

a. They must know the congressional staff

b. They must be represented by a professional organization

c. In order to participate in the public policy process, NI Leaders must be professional in their communication with congressional staff

d. In order to participate in the public policy process, NI Leaders must be knowledgeable and current in public policy and regulatory initiatives

Question 18.4: Skills needed by NI Leaders to engage in public policy include what?

a. Strategists who can engage stakeholders across multiple spectrums to ensure technological needs are understood and met

b. Leaders

c. Effective communicators

d. All of the above

Question 18.5: Professional organizations need what kind of support to engage in public policy?

a. Financial

b. Insurance

c. Malpractice

d. Ability to write rules

Question 18.6: What are some of the ways NI leaders can prepare for public policy involvement?

a. Only a master's in public policy can help you learn how to be involved

b. Participation in task forces, summits, conferences; creation of white papers; lobbying and support of lobbying efforts; membership in relevant organizations; acting as an expert witness; and leading selection committees.

c. Only by working on a congressional staff can you learn the public policy process

d. Only participation in writing policies for a government agency or vendor organization can help you prepare for public policy involvement

Question 18.7: Name four professional organizations that influence public policy for NI in the United States?

a. HIMSS, AMIA, ANI, and ANA

b. ADA, CMS, ONC, and FDA

c. ANA, ANIA, AMIA, and CMS

d. AHRQ, CMS, FDA, and HHS

Question 18.8: True or False? The purpose of educating nurses about public policy advocacy is to encourage the nursing profession to collaborate, educate, and coordinate efforts in policy formulation to support nursing's roles in quality, safety, and patient advocacy.

Question 18.9: What were two documents written to describe nursing participation in PPACA?

a. The American Nurses Association (ANA) created Healthcare Reform: Key Provisions related to Nursing and the American Association of Colleges of Nursing (AACN) created Patient Protection and Affordable Care Act which provide charts outlining how the law supports continued nurse education and all sectors of the nursing workforce (ANA, 2010; AACN, 2010)

b. Robert Wood Johnson created a special interest working group report to describe participation in PPACA

c. The Institute of Medicine created a response to the PPACA on the role of nurses

d. ANI proposed a summit on PPACA

Question 18.10: The public policy process includes all of the following components EXCEPT?

a. Nearly every aspects of the healthcare system including finance and reimbursement are influenced by public policy

b. Nearly every aspect education; facilities, products, and services; professional practice and workforce capacity

c. Nearly every aspect of technology, including health IT are influenced by public policy

d. Nearly every aspect of how to select and implement EHRs are influenced by public policy

ANSWERS AND EXPLANATIONS

Question 18.1: (a) Public policy is the action taken by government to address a particular public issue. Local, state, federal, and international government organizations all craft and implement public policy to protect and benefit their populations.

Question 18.2: (b) The formation of good public health policy relies on quality, unbiased, substantial data as well as the expertise of those who provide care within the healthcare environment.

Question 18.3: (d) In order to participate in the public policy process, NI Leaders must be knowledgeable and current in public policy and regulatory initiatives.

Question 18.4: (d) All of the above. Informatics nurses must be (1) strategists, (2) leaders, and (3) effective communicators; they must (4) engage stakeholders across multiple spectrums to ensure patient, nursing, and technological needs are understood and met.

Question 18.5: (a) According to Suzanne Begeny, Director of Government Affairs at the American Association of the Colleges of Nursing, "In order to effectively shape public policy, nurses need to realize that it takes a significant financial investment to compete on the national level."

Question 18.6: (b) Participation in task forces, summits, conferences; creation of white papers; lobbying and support of lobbying efforts; membership in relevant organizations; acting as an expert witness; and leading selection committees.

Question 18.7: (a) HIMSS, AMIA, ANI, and ANA

Question 18.8: True. The purpose of educating nurses about public policy advocacy is to encourage the nursing profession to collaborate, educate, and coordinate efforts in policy formulation to support nursing's roles in quality, safety, and patient advocacy.

Question 18.9: (a) The American Nurses Association (ANA) created Healthcare Reform: Key Provisions related to Nursing and the American Association of Colleges of Nursing (AACN) created Patient Protection and Affordable Care Act which provide charts outlining how the law supports continued nurse education and all sectors of the nursing workforce (ANA, 2010; AACN, 2010).

Question 18.10: (d) Nearly every aspects of the healthcare system including finance and reimbursement; education; facilities, products and services; professional practice and workforce capacity; and technology, including health IT, are influenced by public policy. It does not include how to select and implement EHRs.

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Communication Skills in Health IT, Building Strong Teams for Successful Health IT Outcomes

• OBJECTIVES

1. Discuss the importance of communication in health IT to achieve adoption of EHR technology.
2. Define the elements of effective communication plans.
3. Identify the stakeholders to consider in communications plans.
4. Describe the federal agencies, regulations, and other factors that affect health IT.

• KEY WORDS

Governance
Communication
Electronic health record
Physicians
Informaticists
Patient

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of poor communication skills? Can you give examples of good communication skills? Why are good communication skills important? Why would good communication skills be important in healthcare? How do good communication skills improve patient safety and decrease medical errors? How does HIT support communication between healthcare providers and patients? How does the EHR improve communication between healthcare providers and patients? Should healthcare professionals use social media?

For a WIIFM statement, say to the class, "Communication skills are extremely important to improve the quality and safety in healthcare. In this chapter, you will learn about communication strategies that have proven effective in the selection and implementation of EHRs to support the needs of patients, physicians, nurses, and the caregiver workforce. The chapter examines the importance of communications in HIT initiatives, the customers and players, the components of the communication plan, as well as industry and governmental considerations (roles of federal agencies, federal regulations, and health information exchange). The chapter provides a synopsis of the burgeoning role of mobile applications and social media." As a health informatician, it is important to understand the importance of communication in healthcare IT.

Class Preparation

1. Review the references listed at the end of the chapter
2. Review the ONC and the CMS Web sites at http://www.healthit.gov/ and http://goo.gl/3GjUMc for current healthcare IT communication initiatives
3. Review the Pew Research Internet Project Web site at http://www.pewinternet.org/topics/health/
4. Review the Mayo Clinic Center for Social Network Web site at http://network.socialmedia.mayoclinic.org/mccsm/
5. Encourage students to visit these Internet Web sites

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

INTRODUCTION

A. Landmark Legislation
  1. American Recovery and Reinvestment Act (ARRA)
  2. Health Information Technology and Economic and Clinical Health (HITECH) Act
    a. Centers for Medicare and Medicaid's (CMS) Meaningful Use of EHRs
  3. These programs provided more than $22 billion in incentive payments for eligible physicians and healthcare providers who successfully meet increasingly stringent requirements for EHR implementation over the next five years

B. Integration of health IT has been challenging due to complexity in healthcare organizations

C. Healthcare leaders and providers realize that communication and patient engagement are fundamental to improving the value of healthcare

D. Findings from research studies indicate that good physician-patient communication
  1. Leads to improved patient satisfaction
  2. As well as increased willingness of patients to share pertinent data
  3. Adhere to medical treatment
  4. Follow advice

E. Effective communication programs with physicians are a priority for hospitals and physician practices adopting EHR and CPOE systems to reduce the likelihood of costly, high-risk experiences

F. Continuous learning healthcare systems depend on the involvement of all stakeholders
  1. To manage communications effectively
  2. To share them inclusive of the healthcare community

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

IMPORTANCE OF COMMUNICATIONS IN HEALTH IT INITIATIVES

A. Many healthcare organizations have implemented EHRs creating the need for effective and tactical communication plans

B. According to the IOM's Evidence Communication Innovation Collaboration
  1. "Communication is central to transforming how evidence is generated and used to improve the effectiveness and value of healthcare"

C. Use of the Internet by patients seeking health information underscores the need for clear and consistent communication

THE COMMUNICATIONS COMPLEXITY CHALLENGE

A. Healthcare systems face unique challenges in communication because of a variety of stakeholders with competing goals and definitions of quality

B. William Rouse characterized healthcare organizations as "complex adaptive systems"
  1. "Nonlinear and dynamic and do not inherently reach fixed-equilibrium points. As a result, system behaviors may appear to be random or chaotic"
  2. "*They are composed of* *independent agents* *whose behavior is based on physical, psychological, or social rules rather than the demands of system dynamics*"
  3. "*Because agents' needs or desires, reflected in their rules, are not homogeneous, their* *goals and behaviors are likely to conflict**. In response to these conflicts or competitions, agents tend to adapt to each other's behaviors*"
  4. "*Agents are* *intelligent**. As they experiment and gain experience, agents learn and change their behaviors accordingly. Thus overall system behavior inherently changes over time*"
  5. "*Adaptation and learning tend to result in* *self organization**. Behavior patterns emerge; they are not designed into the system. The nature of emergent behaviors may range from valuable innovations to unfortunate accidents*"
  6. "*There is* *no single point of control**. System behaviors are often unpredictable and uncontrollable, and no one is 'in charge.' Consequently, the behaviors of complex adaptive systems can usually be more easily influenced than controlled*"

C. Planned, strategic, broad-based communication is the best tool in effecting positive change

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

LEADERSHIP AND GOVERNANCE

A. The introduction of EHRs in healthcare organizations drives transformational change in
  1. Clinical and administrative workflows
  2. Organizational structure that exists between clinicians as well as with administrators
  3. Relationships between frontline works, physicians, administrators, and patients

B. An essential part of risk mitigation in care-delivery reform through health IT is the planning and implementation of organizational communication initiatives that help to achieve the aims of an enterprise-wide governance team

C. Responsibilities for communication initiatives should be shared between the healthcare system leaders, champions, informaticists, and those in charge with oversight of health IT systems

D. Messaging through electronic, in-person, or video media options from the chief executive officers and board members of governance groups solidifies the importance of enterprise-level health IT projects

E. Communication leaders from the organization should be involved in developing the governance and communication plan to align with or to evolve the culture of the organization

F. Among Tenet's many successes, the IMPACT Program (Improving Patient Care through Technology) continues to support the execution of unified, shared, and consistent messaging

G. "Today, clinical IT is finally being universally viewed as a critical component of healthcare reform, and we are only going to get one chance to do this right. This means having everyone in the organization, from the Board Members to the bedside clinicians, all focused on the same plan, the same tactical initiatives, and the same outcomes"

RULES FOR GOVERNANCE

A. Enabling governance committees requires a solid set of rules

B. A set of roles have been defined in "iGovernance"

1. Hardwire the committee
2. Set clear levels of successive authority
3. Do real work every time
4. Form no governance before its time
5. Put someone in charge who can take stand

C. In the ONC framework, milestones and expected outcomes are presented rather than specific steps for governance

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

FOCUS ON INDUSTRY PLAYERS

A. Those who are engaged in EHR implementation initiatives should be involved in communication associated with multi-year programs

B. Patients and Communities

1. In the 2001 report, "Crossing the Quality Chasm: A New Health System for the 21st Century," the IOM established the need for patient-centered communications and support
2. Communications are also required to support healthcare reform at the community level as demonstrated in CMS's 2011 establishment of the Three Part Aim for the Medicare Shared Savings Program

C. Physicians

1. Introduction and adoption of EHRs by health systems or practices cannot be expected to succeed without the endorsement and ownership of the physician community
2. The ONC through its regional extension centers (RECs) has recruited "physician champions" to help other physicians get over the hurdle of digitizing their medical records
3. There is a continued need to directly engage physicians in health IT implementation through comprehensive communication initiatives

D. Nursing Workforce

1. Nurses are on the front line of health IT reform
2. According to Joyce Hahn, "Nurses represent the largest potential users of electronic health records"
3. The role of communications is not limited to training nurses in the use of EHR systems, but preparing them to fully engage in the design, testing, and implementation of EHRs to support improved care coordination and continuity of care
4. The clinical nurse informaticist has become a key role in ensuring the adoption of EHR technology and sustainment of benefits
5. Nursing Advisory Teams (NATs) can function as decision-making bodies
6. Nurses and nurse informatics can be key persons in the communicative approach with physicians
7. Nurses are able to remove the barriers and concerns that physicians initially express when using EHRs, specifically computerized order entry
8. Provision of key talking points and documented benefits should be formally incorporated into the communication plan

E. IT Departments and Multidisciplinary Project Teams

1. IT departments and project teams are responsible for meeting the challenges of new system introductions as well as managing upgrades
2. Per The CIO's Guide to Implementing EHRs in the HITECH Era, the teams' roles in communication efforts involve engaging clinicians in staff positions, confirming commitments, managing change, and setting EHR deployment strategies
3. Organizational newsletters are effective vehicles for sharing best implementation strategies
4. Newsletters should be distributed on a consistent basis, have a recognizable template of content, and a variety of communication mediums such as e-mail, print, and company Intranet

F. Patients and Consumers

1. One imperative in the Patient Protection and Affordable Care Act (ACA) is that providers must encourage patients to engage in their own care and communicate electronically with providers
2. Hospitals face some resistance from patients who would rather speak directly with their physician or do not understand the benefits of reviewing and maintaining their own health records
3. To combat such challenges, hospitals are creating patient-friendly portals
4. Some hospitals are interacting directly with private physicians to ensure follow-up care
5. It should be noted that to ensure success, the language and content of patient communication will be different for that used among clinicians
6. All the components of health literacy are critical considerations when crafting communications for the patients and consumers

   7. The RECs are considered as an effective communication tool and methodology related to patient engagement
- **G.** Healthcare System Leadership
   1. Communications led by an executive-level steering committee represent the beginning and the end of successful health IT implementation processes
   2. The top of the organization not only establishes the size of the investment the organization makes but also communicates "the broad strategies for IT in advancing business goals and, ultimately, acting on the results of a consistently applied proposal and prioritization regimen"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

BUILDING A COMMUNICATIONS PLAN

- **A.** Kaiser Permanente credited their communication initiatives for "creating awareness, building knowledge, managing expectations, motivating end users, and building proficiency," for their KP HealthConnect® EHR
   1. Kaiser Permanente as part of their communication plan used a central Intranet site, leadership messaging, weekly e-newsletters, regional communication tactic, and videos
- **B.** Eckes and Staren offered the following idea in their 2009 article, "Communication Management's Role in EHR Success"
   1. Fact sheets, newsletters, and posters
   2. Road shows
   3. Town hall meetings
   4. Standard meeting reports
- **C.** An e-newsletter can be used to communicate success stories
- **D.** Communicating an EHR implementation plan to clinicians is essential for EHR success
- **E.** Communication about changes should include the following four steps
   1. Create process teams
   2. Communicate the logic for EHR adoption
   3. Define measurable success factors
   4. Clearly communicate results

PROJECT PHASES AND THE COMMUNICATION FUNCTIONS

- **A.** Health IT projects often unfold over multiple-year periods with pre-adoption (selection), pre-implementation, implementation (go-live), and post-implementation (outcomes) as the four major phases
- **B.** It is important that communication plans be built and integrated within the four major phases of adoption
- **C.** The information needs of stakeholders will vary as the projects evolve and mature
- **D.** A variety of formal and informal communication media will be needed to reach the different health-system groups
- **E.** Patients should be included in EHR communication

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

COMMUNICATIONS METRICS

- **A.** The best metrics to measure communication program effectiveness are the same used to present the stories of successful health IT implementation

KEY INDUSTRY CONSIDERATIONS

- **A.** Those responsible for building communication strategies must do so in the context of industry change beyond hospital walls
- **B.** Innovation in mobile devices and social media platforms have broadened, enriching communication options to support successful health IT integration
- **C.** Actions of the Federal Government to ensure increasing volumes of trusted, secure health information exchange are constantly redefining how and what the healthcare industry can expect to communicate across the continuum of care in the future
- **D.** Communication planning in support of health IT initiatives must reflect the forces driving such change:
   1. An expanding world of media
   2. The roles of federal healthcare agencies
   3. The adoption of regulatory standards as they are driving the evolution of health information exchange itself

SOCIAL MEDIA AND eHEALTH INITIATIVES—MEETING THE HEALTH COMMUNICATION NEEDS OF COMMUNITIES

- **A.** Physicians and clinicians are increasingly communicating among themselves and with their patients due to an explosion of mobile health device technology
- **B.** Mobile technologies are rapidly evolving
- **C.** Clinicians are increasingly depending on them to
   1. Document patient visits
   2. Manage clinical workflows
   3. Conduct research on technical and clinical issues
   4. Receive alerts regarding patient conditions
- **D.** The deployment of mobile devices in the marketplace may be surpassing the pace for which security precautions can keep pace
- **E.** To address security issues, the FDA released final guidelines for mobile technology use in September 2013
- **F.** These are nonbinding guidelines

G. The guidelines provide a roadmap for current use and the development of future medical apps

H. The guidelines may play a role in other eHealth initiatives as more and more consumers turn to mobile devices to interface with patient portals to communicate with their providers and maintain personal health records

I. New digital media vehicles encompass a multitude of healthcare-specific social media Web sites such as

  1. PatientsLikeMe

  2. Sermo

  3. Diabetesmine

J. Keys to enabling productive communication with today's interactive tools recognize that

  1. "Health has become more participatory

  2. Data has become the new 'Intel Inside' for systems supporting the 'vital decisions' in health

  3. A sense of 'collective intelligence' from the network would supplement traditional sources of knowledge in health decision-making"

K. Social media sites bring new opportunities to improve provider-to-provider communication within physician-centric channels

  1. Sermo

  2. QuantiaMD

L. Some social networking sites support patient communities that bring new opportunities for marketing of services and dissemination of best practices

M. Healthcare organizations have become more vigilant in establishing rules and policies governing participation in social media

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

ROLE OF FEDERAL HEALTHCARE AGENCIES

A. Healthcare reform during the past decade has been defined, spearheaded, and guided by federal agencies, armed with ARRA and HITECH legislation to provide funding, oversight, and industry-level guidance on the implementation and adoption of health IT throughout the United States

B. The US Department of Health and Human Services (HHS) is leading the government's healthcare initiatives

C. Two key divisions of HHS are CMS and ONC

D. Under HITECH, CMS is charged with advancing health IT through

  1. Implementing the EHR incentive programs

  2. Helping define meaningful use EHR technology

  3. Drafting standards for the certification of EHR technology

  4. Updating health information privacy and security regulation under HIPAA

E. The Health IT Policy Committee makes recommendations to ONC on the development and adoption of a nationwide health information infrastructure, including guidance on what standards for exchange of patient medical information will be required

F. The Health IT Standards Committee focuses on recommendation from CMS, ONC, and the Health IT Policy Committee on standards, implementation specifications, and certification criteria for the electronic exchange and use of patient health information

G. Understanding the role of the agencies and committees and keeping abreast of their actions is an important responsibility for those engaged in planning and delivering communications that support health IT adoption

H. Individually and collectively the agencies and committees help drive the definition of incentive payment requirements across the three stages of EHR Meaningful Use

I. Each stage not only creates new health IT performance requirements but also defines the kinds of information exchange—in themselves forms of communication that will be required between healthcare entities

J. Stage 1—Beginning in 2011 as the incentive program starting point for all providers

  1. Consists of transferring data to EHRs and being able to share information

K. Stage 2—To be implemented in 2014 under the current proposed rule and will extend to 2016

  1. Included new standards such as online access for patients to their health information and electronic health information exchange between providers

L. Stage 3—Expected to begin in 2017

  1. Is projected to include criteria that demonstrate improvement in the quality of healthcare

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

ROLE OF REGULATORY STANDARDS AND THE EVOLUTION OF HEALTH INFORMATION EXCHANGE

A. An increasing number of standards in the area of health, health information, and communication technologies are helping to guide the healthcare industry toward interoperability between independent entities and systems

B. The goal is to support the safe, secure, and private exchange of PHI in ever-increasing volumes to improve the quality of care

C. The Health IT Standards Committee is the primary advisory committee working to fulfill this mandate

D The Health IT Standards Committee has established a number of workgroups as subcommittees

  1. The subcommittees are formed around subjects such as Clinical Operations, Clinical Quality, Privacy and Security, Implementation, Vocabulary Task Force, Consumer Technology, and the Consumer/Patient Engagement Power Team

2. All workgroup meetings are held in public, and notices for each meeting appear on the ONC Web site and in the Federal Register

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CHAPTER REVIEW: FUTURE OF COMMUNICATIONS IN HEALTH IT

A. This chapter has addressed issues regarding the importance of communication and the development of effective communication strategies in strengthening initiatives ranging from governance effort to physician-to-patient partnerships as part of successful EHR implementation

B. Key takeaways to consider include the following:

   1. Coordinated, cross-enterprise communications strategies are critically important parts of health IT implementations, including the development of governance structures supporting the introduction and adoption of EHR systems
   2. The customers and players engaged in communications include patients and communities, physicians, nurses, clinical informaticists, project teams and IT departments, and health-system leadership. Remember that patient-centricity, the Meaningful Use program, and physician and nurse engagement are all critical points in the communication initiatives for these participants
   3. Vehicles in a communications plan can include an Intranet, print media, road shows, town hall meetings, and standard meetings to be used through all phases of a project and the success of such projects can be the best measure of the communication plan's effectiveness
   4. Some of the most powerful forces driving change include social media, mobile devices, and continued healthcare reforms and should be considered when developing communications plans
   5. The ONC's committees, the HIT Policy and Standards Committees, and subcommittees, such as the Implementation Workgroup, are key drivers of national communications important to all stakeholders involved in working toward the meaningful use of EHRs

C. America's healthcare system is a complex, expensive system that needs to learn and adopt continuously to improve the quality of care and outcomes, protect patient safety, and reduce inefficiencies

D. Health IT can increase providers' abilities to share and retain patient information and can support initiatives in patient engagement, care coordination, Meaningful Use, and eHealth

E. With a commitment to the development and execution of communications strategies around the implementation of emerging health IT, higher levels of ownership and commitment by professionals will help to insure the success of the US healthcare reform movement in years to come

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Discuss the importance of communication in health IT to achieve adoption of EHR technology
- Define the elements of effective communication plans
- Identify the stakeholders to consider in communications plans
- Describe the federal agencies, regulations, and other factors that affect health IT

Teaching Tip
Ask the students to define the keywords

- Governance
- Communication
- Electronic health record
- Physicians
- Informaticists
- Patient

CHAPTER REVIEW QUESTIONS

Question 19.1: Effective communication strategies that are required because of the complexity of the healthcare system, and the need to define governance include all of the following EXCEPT:

a. Team building
b. Selecting multidisciplinary members
c. Facilitating the work of the teams
d. Adding payroll increases

Question 19.2: Resolving conflict management can be handled by:

a. Being cognizant of this expected behavior should lead to the inclusion of collaboration opportunities as a part of the communication plan
b. Creating diversions to the conflicting groups
c. Ignoring the conflict and focus on the outcome goals
d. Sending the team out for a retreat and hoping they will resolve their issues

Question 19.3: Essentials elements of the content of a communication plan include all but the following:

a. Performance goal setting
b. Performance appraisal
c. Continuing education
d. Regularly scheduled pizza parties

Question 19.4: Methods for instructional design, training materials, communication strategies include:

- **a.** Fact sheets, newsletters, posters, pre-implementation road shows, town hall meetings, and standard meeting reports
- **b.** Online call centers
- **c.** Help desk
- **d.** No training materials are needed

Question 19.5: The Institute of Medicine's six aims for improving quality of care in the Quality Chasm report include:

- **a.** Effective, safe, equitable, patient-centered, timely, and efficient aims
- **b.** Notable and capturing the eye of the consumer and the press, cost-efficient, trusted, consumer-centric, and outcome-driven
- **c.** Efficient and effective, patient-centered, cost-efficient, trusted, and outcome-driven aims
- **d.** None of the aims listed

Question 19.6: What is the most common reason for lack of adoption of EHR and CPOE?

- **a.** Lack of sufficient funding
- **b.** Lack of a leadership model and governance structure
- **c.** Insufficient communication and training
- **d.** Insufficient time for meetings

Question 19.7: Who should be involved in governance models in healthcare organizations?

- **a.** All stakeholders
- **b.** Healthcare clinicians only
- **c.** Executive leadership only
- **d.** Nurses and pharmacists only

Question 19.8: What is a key component of the Tenet Healthcare IMPACT Program for governance?

- **a.** It engages the staff in line positions
- **b.** It includes multidisciplinary staff
- **c.** It uses a three-tiered organizational structure
- **d.** It uses the information technology and informatics staff effectively

Question 19.9: What is not one of the iGovernance articles to live by for governance committees?

- **a.** Have well-planned meetings with agendas and outcomes
- **b.** Hardwire the committees
- **c.** Set clear levels of successive authority
- **d.** Form no governance before its time

Question 19.10: Which group is the largest potential user of the EHR?

- **a.** Consumers
- **b.** Medical staff
- **c.** Nursing workforce
- **d.** Physician assistants

ANSWERS AND EXPLANATIONS

Question 19.1: (d) Team building includes leading teams, selecting members, facilitating teams, participating in teams, assigning roles, and promoting accountability. Adding payroll increases is not an effective communication strategy.

Question 19.2: (a) Being cognizant of this expected behavior should lead to the inclusion of collaboration opportunities as a part of the communication plan.

Question 19.3: (d) Performance goal setting, performance appraisal, continuing education, and competency development are elements of content in a communication plan. The regularly scheduled social pizza parties are not essential.

Question 19.4: (a) Fact sheets, newsletters, posters, pre-implementation road shows, town hall meetings, and standard meeting reports.

Question 19.5: (a) Effective, safe, equitable, patient-centered, timely, and efficient aims.

Question 19.6: (c) Insufficient communication and training are common causes of lack of adoption of EHR and CPOE.

Question 19.7: (a) All stakeholders need to provide input into the governance models in healthcare organizations.

Question 19.8: (c) The Tenet Healthcare IMPACT Program for governance engages the corporation, the regional operation, and the hospitals in a coordinated three-tiered organizational structure of governance.

Question 19.9: (a) Having well-planned meetings with agenda and outcomes is important but it is not one of the rules to live by for governance.

Question 19.10: (c) The nursing workforce is potentially the single largest group using the EHR.

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Assessing the Vendors

• OBJECTIVES

1. Describe an approach to evaluate the vendor marketplace for health information technology solutions.
2. Discuss the evolution of the healthcare technology marketplace .
3. Distinguish the custom development or "build" approach from the purchasing of commercially available solutions or "buy" approach.
4. Identify two or more criteria that may be used to differentiate one vendor from another.
5. List the key Guiding Principles of a Vendor Analysis Methodology.

• KEY WORDS

Best of breed
Change management
Return-on-investment (ROI)
Request for Information (RFI)
Request for Proposal (RFP)
Single vendor

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Do you use a method to select computer hardware? Do you use a method to select computer software? Why is it important to have a systematic method to select computer hardware and software? Have you ever developed an RFP/RPI? Why was it important to develop the RFP/RFI? Why is the submission of an RFP/RFI important in the selection of health information technology?

In a WIIFM statement, say to the class, Assessing the Healthcare Information Technology market can be a daunting task. In the United States alone, more than 1000 vendors exhibit at the Health Information Management Systems Society (HIMSS) annual conference. Navigating the field of potential vendors and assessing solution requires a skilled and experienced leader and a team committed to a fair, unbiased, and thoughtful analysis. It is an immense responsibility to lead or participate in the selection of a new vendor partner for an organization. Following a data-driven and evidence-based Vendor Assessment Methodology provides the opportunity for a thoughtful and objective analysis of the vendor marketplace. As a nurse, it is important to understand how to select a vendor for the health information technology.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

INTRODUCTION AND OVERVIEW

Teaching Tip
Provide this information, Assessing the Healthcare Information Technology market can be a daunting task. It is estimated that the global health IT market will reach $56.7 billion by 2017, an increase from the 2012 market value of $40.4 billion. In the United States alone, more than 1000 vendors exhibit at the HIMSS annual conference. Navigating the field of potential vendors and assessing solution requires a skilled and experienced leader and a team committed to a fair, unbiased, and thoughtful analysis.

Build versus Buy

1. In the early days of Healthcare Information technology many pioneering organizations elected to develop and support their own electronic health record software
   a. The idea of developing in-house applications, often referred to as the “build” approach, was necessary at a time when commercial options were limited
   b. The benefits of the build approach included the ability to program specifications to the organization’s unique requirements and the flexibility to apply future updates or enhancements whenever they were needed
2. The cost of the build approach, however, was great and many organizations could not compete within their market for the technical resources required to develop and support homegrown solutions
   a. There was also a great institutional risk associated with this approach
   b. Mission critical applications, for example, programmed by an employee could result in a single point of failure should that individual no longer be available to the organization
3. The commercial healthcare information technology vendor market began to flourish in the middle of the 20th century with many of the early solution offerings focused on financial and back office functions
   a. As technology continued to evolve, so too did the market
   b. Demand for solutions increased steadily and over time vendors began to diversify their portfolios to include more and more applications across different settings
4. Today, there are many categories of vendors in the market offering a wide variety of solutions
   a. The competition has helped to make purchasing or buying a solution the more popular choice by far
   b. This “buy” option as it is commonly referred to has created a robust and thriving health IT marketplace

Vendor Assessment Methodology

1. Effectively assessing the vendor marketplace requires a data-driven methodology and approach that will guide the organization through a vendor analysis process

Teaching Tip
Refer to Figure 20.1, Vendor Assessment Methodology.

   a. Throughout the methodology Key Guiding Principles are embedded to ensure adherence to proven best practices
2. Understanding the steps of the methodology
   a. Along with the Key Guiding Principles
   b. And incorporating these into a well-developed and well-managed project plan
   c. Will help to ensure that the organization is applying a fair and unbiased approach to assessing potential vendor solutions

Teaching Tip
Refer to Figure 20.1, Vendor Assessment Methodology.

Key Guiding Principles

1. The Key Guiding Principles include
   a. Manage the Change;
   b. Maintain and Document Objectivity
   c. Think Process; Not Department
   d. Use the Data; Trust Your Gut
   e. Make a Commitment

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

VENDOR ASSESSMENT METHODOLOGY

Guiding Principle: Manage the Change; Communicate

1. Whether large or small the introduction of new technology into an environment will have an impact on users and potential patients
   a. Effectively managing this change at both the individual and institutional level will be a critical success factor
2. In many ways the selection project itself is an opportunity to engage users and begin the process of introducing change
   a. As the team begins to assemble its plan to assess vendors it should remember that communication with all stakeholders is important
   b. While it is not possible to have every stakeholder or employee of the organization actively participating in each step of the process, it is possible and highly recommended for teams to effectively communicate status and inform all of the progress
3. Guiding Principle #1 is “Manage the Change; Communicate” and this cannot be stressed enough
   a. Large-scale transformation efforts such as new technology implementations may begin with an Organizational Change Readiness Assessment prior to a Vendor Assessment

  - **b.** In today's rapidly changing healthcare environment the pace and degree of change can be overwhelming for the organization and for individuals
  - **c.** An Organizational Change Readiness Assessment provides a mechanism to understand the organization's appetite and capacity for change and can help inform the Vendor Assessment effort

Teaching Tip
Provide an example of a Readiness Assessment for a physician practice environment

4. It has been said that successful implementation of technology begins with early end user engagement
   - **a.** A change management strategy grounded in solid communication that is incorporated throughout the project is the best defense against resistance to change that may occur in any organization
   - **b.** Examples of communication strategies used during a vendor assessment include
     - **(1)** Newsletter publication on project goals and status
     - **(2)** E-mail or intranet communication about the project
     - **(3)** Town hall meetings led by organization leaders to provide status and answer questions
     - **(4)** Posters communicating the anticipated timeline and reasons for change
     - **(5)** Contests to name or internally brand the project

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Strategy

1. The first major step in the Vendor Assessment Methodology is "Strategy"
   - **a.** This phase of the methodology is typically led by leadership and is intended to provide the structure and strategic alignment and direction necessary to support the entire effort
   - **b.** The Strategy phase typically focuses on four key strategic considerations
2. These are
   - **a.** Business drivers ("Why are we doing this?")
     - **(1)** An important first step in assessing the vendor marketplace is to ask "why?"
     - **(2)** Or what are the business or clinical drivers behind the organization's need to evaluate vendor solutions in the first place?
     - **(3)** Establishing the need for change and having it clearly articulated by leadership is also an important element of an effective people and organizational change management strategy
     - **(4)** There may be a number of reasons why an organization needs to assess the health IT vendor market. Some of these reasons may include:
       - **i.** New or pending regulatory requirements unmet by the current vendor
       - **ii.** Current solution outdated, no longer supported
       - **iii.** Changing business needs not met by current solution
       - **iv.** Merger with another institution on a different platform
       - **v.** New enabling technology required to support improved care delivery/practice
       - **vi.** Leadership decisions to change or introduce new technology
       - **vii.** Current solution no longer meets business/clinical requirements, such as personalized healthcare
       - **viii.** Poor service or instability of current vendor
     - **(5)** Understanding the organization's unique business drivers for assessing the market and documenting these as part of a Vendor Assessment project charter is essential

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Operational and IT Vision ("What are we going to look like in the future?")

1. It is important for organizations making investments in technology solutions to consider the long-term outlook and impact
2. Most organizations will have a strategic plan which can provide some insight into the future direction of the enterprise
3. Leadership must fully consider the technology implications of various business strategies
4. Consider, for example, the potential technology impacts for the following healthcare-related strategic initiatives
   - **a.** Becoming an Accountable Care Organization (ACO). *Increased need to manage data on populations and predictive analytics to support transitions of care*
   - **b.** Merger and acquisitions activity. *Data migration and integration of technology platforms across an enterprise*
   - **c.** Changing payment models focused on quality. *Data and quality reporting needs*
   - **d.** Clinician talent acquisition strategies. *Technology and tools to enable and support leading clinical practice*
   - **e.** Patient Engagement Initiatives. *Technology tools such as patient portals and data and information to effectively engage patients and families*
5. The operational vision helps to describe what the future operational environment of the organization may look like
6. It is important to also understand the overall Information Technology strategy and vision during the initial phase of the Vendor Assessment Methodology

7. The IT strategy will often describe the organization's overall approach to vendor solutions and products in the context of an existing or future IT portfolio
8. There has been an effort to minimize the number of vendors included in an IT environment
9. Organizations that have embraced the **best-of-breed** model found that managing communication and integration between multiple vendors was challenging
10. It is well understood that there is not a **single vendor** who meets all of the functional and technical needs of a healthcare enterprise
11. Most organizations are attempting to minimize the number of vendors in their portfolio in the hope of achieving better interoperability between key systems
12. Where an organization is and most importantly, where they want to be in the future along this continuum between best of breed and single vendor is an important strategic element to understand
13. Both the Operational and IT strategies are important inputs for the Vendor Assessment Methodology
14. Anticipated solution benefits should be clearly defined and aligned with the organization's overall strategic direction
15. Leadership involvement is essential in order to ensure this alignment of the institutional goals and objectives with expected solution benefits

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Independence and Compliance ("Is the process fair and defensible?")

1. One of the key strategic principles of a well-structured vendor analysis is independence
2. An independent vendor analysis process would be free of bias and would result in an objective decision for the organization
3. It is important for all members of the team to abide by the guidelines established to ensure strict independence
4. These guidelines might include
    a. Acknowledging any real or apparent personal conflicts of interest. Team members that have relationships with representatives from one of the vendors under consideration or members holding a financial interest in one of the companies would be examples of a personal conflict
    b. Having a well-defined and adhered to vendor "no gift" policy
    c. Agreeing to no outside contact policy during the procurement such that vendors cannot circumvent established communication channels
    d. Strictly managing internal and external communication and assuring that information is shared with vendors in a timely, consistent, and professional manner
5. Oftentimes organizations pursuing large-scale vendor assessments will look to external consulting firms to assist in guiding the organization through the process
6. The consulting firm selected as well as the resources assigned to the team should be held to the same standards relative to independence and bias
7. With healthcare organizations spending and investing tens and even hundreds of millions of dollars on technology solutions there is an increase in oversight and scrutiny from multiple stakeholders
8. Public and private boards, for example, may require detailed information regarding the selection of a particular vendor
9. It is necessary for those who lead these efforts to maintain and document objectivity throughout the process
10. This documentation would include a project charter, a work plan, timelines, status reports, correspondence, and meeting minutes to name a few
11. Project documents should be maintained in a secure place
12. Project documents should provide a detailed chronology of all activity and they should be written with sufficient detail to stand alone upon review
13. The team should anticipate that all project documents will come under some degree of scrutiny by those outside of the project in the future

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Guiding Principle #2—Maintain and Document Objectivity

1. Some of the indicators of a fair and objective system selection process are
    a. All vendors respond to the same RFI/RFP format
    b. There is a single point of contact for vendor questions
    c. Vendors are asked not to interact with others in the organization
    d. RFI/RFP released to vendors at the same time with the same deadlines
    e. Any questions asked by and responded to are shared with all vendors
    f. Demonstration scripts are provided at predetermined intervals in advance so that each vendor is provided the same amount of preparation time
    g. Demonstration environment and timing is as consistent as possible for all vendors
    h. Demonstrations are managed and facilitated fairly and consistently
2. In some instances there may be local or regional requirements that must be considered from a compliance perspective
3. A Certificate of Need (CON) process, for example, is required in some states under certain conditions

Teaching Tip

Refer to Figure 20.2, States requiring CON and those that do not

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Financial and Return-on-investment ("What are the costs and benefits?")

1. Lastly, and equally as important, the leadership team must provide some parameters around anticipated solution costs and benefits
2. Oftentimes with large-scale investments the organization's Board of Directors, including the Finance and Investment Committees may be involved to help provide some strategic guidance for
    a. The leadership and
    b. The Vendor Assessment project team as it relates to financial matters
3. This may also include the need to seek funding from external sources, including capital and bond markets
4. The leadership team and the Board of Directors are often focused on the anticipated ROI model of the proposed solution
5. To the extent that they exist the Vendor Assessment project team should fully understand some preliminary assumptions made relative to solution costs and benefits
6. It will be vitally important for the team to
    a. Secure data early in the effort that helps to support and compare the projected financial impact analysis
    b. An actual estimate based on data directly from the vendors
7. Cost estimates will be discussed further in the Define phase

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Define

1. The Define phase of the Vendor Assessment Methodology is intended to
    a. Create the list of prospective vendors
    b. Document the functional and technical solution requirements
    c. To formally request information or a formal proposal from targeted solution providers
2. The major tasks in this phase are
    a. Conduct market research and understand key market differentiators
    b. Develop functional and technical requirements
    c. Develop and Submit RFI/RFP

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Conduct Market Research and Understand Key Market Differentiators

1. Conducting a market scan of potential vendors is an important first step of the Define phase
    a. An effective high-level market scan is as much an art as it is a science
    b. While there are many resources available within the industry the best and most reliable way to attain an appreciation of any vendor and solution is through networking and relationships
2. Reaching out to colleagues or networking with peers who have "been there; done that" is a recommended first step in a successful market scan
    a. Participating in trade shows or industry conferences at a local or national level can also provide an opportunity to connect with colleagues and to speak candidly with vendors who attend or exhibit
    b. Lastly, there is a lot of information available on the Internet with varying degrees of reliability
    c. Searching targeted vendor Web sites and/or user groups is often helpful in obtaining baseline information, but should be reviewed with an eye toward bias, reliability, and credibility
3. It is also recommended to conduct a formal literature review
    a. As health information technology continues to evolve there is an ever-increasing body of knowledge in the formal, peer-reviewed literature
    b. While the literature may not have vendor-specific information it may provide some insight into solutions and anticipated benefits
    c. A team that is considering a new acute care EHR for example, may search the formal literature on Computerized Prescriber Order Entry (CPOE)
    d. This research will provide a sound basis not only for the selection, but for the identification of the key benefits of the new technology
4. This review may also alert the selection team to potential unintended consequences of new technology
    a. Together, these documented benefits and unintended consequences help inform the understanding of the market and the solution being considered
    b. For a fee, industry and market research firms offer another way to gain information about vendors and their solutions

Teaching Tip
Several examples of industry resources are provided in Table.

5. As the team begins to understand the market they will find that the vendors in the health information technology market differentiate themselves across several dimensions
    a. Among others, there are business, technical, and solution differentiators that should be considered as part of the Define phase of a vendor assessment

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Business Differentiators

1. **Privately held versus Public companies**
    a. Some health IT vendors are privately held businesses and in some cases wholly owned by the founders
    b. These types of organizations typically make decisions about their business and their solutions based on the company's internal management and leadership
    c. Other vendors in the health IT market are publicly traded organizations who ultimately report to external shareholders
    d. The decisions in these organizations are often highly focused around quarterly earnings targets
2. **Software versus Services versus Hardware**
    a. There are vendors who function purely as software developers
    b. They develop software solutions but are not as interested in generating revenue from other solution components such as hardware or services
    c. Services vendors, on the other hand, are focused on providing management consulting, staff augmentation, or other high demand skills and expertise and do not usually develop software product
    d. Hardware vendors generate revenue primarily from the sale and support of the hardware component of a solution offering and often partner with other firms for software services
    e. It should be noted that these business differentiators are dynamic and can change as a vendor's business evolves
    f. It is also true that a single vendor may differentiate across multiple dimensions

Teaching Tip
Provide the example, there are software vendors, for example, who also offer services and hardware. Just as there are hardware vendors who market, sell, and support software applications.

    g. During a vendor analysis, it is important to understand the potential vendors' primary business differentiators and motivators so that an informed decision can be made
3. **Industry focus**
    a. Another important business differentiator to consider is industry alignment
    b. There are vendors who focus 100% on the healthcare marketplace and others who include industries outside of healthcare in their portfolio
    c. There are pros and cons for each
    d. A healthcare focus offers assurance that a vendor appreciates the unique challenges the healthcare industry faces
    e. On the other hand, the diversity of a company that serves multiple industries could offer innovative solutions to bring forward into healthcare
    f. Understanding which industries the vendors focus can provide insightful information about the organization's past as well as its long-term commitment to providing innovative solutions to the healthcare industry

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Technical Differentiators

Teaching Tip
Provide the following information, there are multiple categories of technical differentiators to consider. Some of these include those related to the development of software products, product line growth strategies, or the solution delivery mechanisms the vendor supports.

1. **Development model**
    a. When evaluating vendors it is necessary to understand the underlying solution development model that is used
    b. The development model for software vendors, for example, may involve open source software (OSS) or a proprietary, vendor controlled approach

Teaching Tip
For more information on OSS, please refer to Chapter 10.

    c. While there is no right or wrong answer for one development model over another
    d. It is important to understand the vendor's approach to development and to recognize how that approach is or is not aligned with the organization's current and future IT strategy
2. **Product line growth**
    a. A vendor's overall strategy for building its product line is another technical differentiator to consider
    b. Some vendors develop all of their solutions internally while other rapidly acquire technologies from other sources and essentially act as a system integrator
    c. Understanding the technical architecture on which the solution is built as well as the history of all solution components can provide valuable information to the team considering a vendor solution
3. **Solution delivery**
    a. There are many options for the delivery of technical solutions to organizations

Teaching Tip
Provide this example, software solutions and EHRs, for example, may reside on computers or servers on the physical premises or they may be hosted remotely.

    b. In addition, many solutions are now being offered by application service providers (ASP) via the Internet through such mechanisms as Software-as-a-service (SaaS)
    c. The team evaluating vendors will need to consider the delivery mode that makes the most sense for the organizations

   d. It is not unusual for vendors to offer multiple delivery options and all should be considered by the team as appropriate

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Solution Differentiators

Teaching Tip
Provide this information, solution differentiators are those characteristics of the vendors' products that distinguish it from competitors. These differentiators include the market segments served, product evolution, integration, functionality, and future product development plans.

1. **Market segments served**
   a. While many vendors claim to offer a "comprehensive" portfolio of solutions most serve relatively small market segments and have a narrow product line

Teaching Tip
Provide the following examples, in healthcare, some vendors, for example, may provide solutions for the ambulatory market while others focus exclusively on the needs of the acute, inpatient setting. Further narrowing can be seen with what is typically referred to as "niche" vendors who service a very specific need. Peri-operative, Maternal Child Health, Behavioral Health, Radiation oncology, Emergency services, are all examples of environments where niche vendors offer solutions.

   b. With the continued consolidation within the industry and the movement toward new models of care delivery, it is important to consider current and future business and clinical needs when analyzing vendors

Teaching Tip
Provide the following example, an organization that operates as an acute care facility today may find that its future includes becoming part of an ACO model, for example, where environments such as post-acute, long term, rehabilitation, and others will need to be considered.

2. **Product evolution**
   a. Understanding the historical perspective of a vendor's product is an essential element of a comprehensive vendor analysis

Teaching Tip
Provide this example, one EHR vendor, for example, may have established roots by developing inpatient clinical solutions while another may have started out as a vendor focused on radiology systems.

   b. Understanding this historical perspective is important in developing an appreciation of the vendor's core competencies and a better understanding of how the solution has evolved over time

3. **Integration**
   a. While some vendors claim to offer an "integrated" solution what they really provide is a franchise model where they purchase or acquire various legacy applications and attempt to integrate them and sell them as a single solution offering

Teaching Tip
See Technical Differentiators above.

   b. It is vitally important to track each product or application back to its genesis to understand more fully whether a solution was developed as part of a single, integrated platform or is a patchwork of interfaced legacy systems

4. **Functionality**
   a. All solutions that enter a commercial market go through a maturity cycle. In the beginning there are wide differences in the features and functions and a limited number of vendors offering the solution
   b. Over time, however, as the product matures and more vendors enter the market, competition creates a leveling of functional differentiators
   c. An assessment of the now mature EHR market in the United States would show that the vendors who have led the market all have products that are similar in their features and functions but differentiate on other elements
   d. This Darwin-like survival of the fittest phenomenon is one of the key benefits of having a competitive, commercial market for solutions
   e. Functionality is a key element of any Vendor Assessment

Teaching Tip
Functional requirements will be explored in more detail in the "Develop Functional and Technical Requirements" section that follows.

5. **Future product development plans**
   a. One of the most important differentiators to understand about a vendor is where they are headed with their product line
   b. In many cases the partnership with vendors can last years or decades
   c. It is important to develop a sense of where the vendor plans to focus development efforts in the next 5–10 years
   d. Alignment of the vendor's strategy with an organization's strategic plan is an important step in assessing a vendor's compatibility to partner with an organization over the long term
   e. This is especially true with understanding the vendors short- and long-term product development plans

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Develop Functional and Technical Requirements

1. Requirements definition is a very important step in the Vendor Assessment Methodology
   a. Requirements can serve multiple purposes
   b. First of all, they help to define current state workflows requirements
   c. They also help to organize the desired future state features and functions
   d. Often referred to as the "wish list," future state requirements provide an opportunity for the Vendor Assessment team to see if a vendor's solution can support the desired future state environment
   e. Requirements may also serve a purpose during the contract negotiation phase
   f. Gaps in functionality, for example, may inform any custom modifications that may be contractually obligated
   g. In addition, some institutions may contractually bind the vendor's response to requirements
2. As discussed, solution requirements can be divided into functional and technical capabilities
3. Functional requirements refer to those features and functions that support workflow of end users

Teaching Tip
Provide the examples, examples of functional requirements in a healthcare software application might include: "Ability to log onto the system," "Ability to register a patient," "Ability to enter an order," "Ability to generate a claim," etc. The US federal government offers a host of templates, best practices, and examples of functional and technical requirements and many other great resources in the "How to implement EHRs" section of the HealthIT.gov Web site. See Step 3: Select or upgrade to a certified EHR.

4. Technical requirements focus less on workflow and more on technical capabilities within the solution

Teaching Tip
Provide these examples, "Ability to interface to Laboratory system," "Supports Window Active Directory," "Ability to send and/or receive HL7 messages," "Complies with HIPAA Technical Security standards," etc.

5. Requirements can be very specific and detailed or they can be high level
6. When the team develops requirements consideration is generally given to the current state as well as the potential or desired future state workflow
7. A Key Guiding Principle that applies to requirements development is to "Think Process; Not Department"
   a. While this principle can be applied throughout the Vendor Assessment Methodology, it is particularly important for requirements development
8. As such, functional requirements should be developed from a process perspective and not a departmental or silo perspective

Teaching Tip
It's important for example, when developing requirements, for medication administration to consider the implications from the patient's perspective as well as the physician (ordering), the pharmacist (verification and dispense), and the nurse (administration and evaluation) perspectives.

9. Approaching requirements from a single discipline, a single department, or one step of the workflow would only partially define what is needed

Teaching Tip
Provide this information, nursing represents the largest segment of the healthcare workforce. In the United States it is estimated that there are 3.1 million Registered Nurses. The table below highlights some sample requirements organized around the Nursing Process. Again, it is important to consider the process and not the department or in this case the nursing perspective alone. Assessment requirements, for example, may lead to an impact for nutrition, respiratory, or rehabilitation services. Keeping this broader, process-focused perspective will ensure that functional requirements are comprehensive. See Table—Sample Functional Requirements.Technical requirements can be complex. The requirements in this section generally pertain to the technical aspects that your system must fulfill, such as performance-related issues, system reliability, and availability issues. This section may include multiple categories of questions that may or may not be able to fit into the structured response (see above) requirement. It is important to develop these requirements in collaboration with subject matter experts from the organization who understand the requirements. See Table—Sample Technical Requirement.

10. **Structured responses**
    a. It is important to structure the response to functional and technical requirements where possible to alleviate ambiguity and facilitate requirements analysis
    b. Best practice is to phrase requirements such that they can be answered in a Yes/No response format
    c. This can be difficult for some requirements, but will provide for a more effective response analysis
    d. Soliciting a Yes/No response is not as simple as it may seem
    e. Recognizing that they are being scored and competition exists, vendors will want to respond to requirements with a "Yes" response
    f. This may introduce some ambiguity, however, and responses should be structured to add clarity
    g. To help alleviate concerns about this ambiguity, vendors should be instructed to respond more accurately through a structured response approach

Teaching Tip
Provide this information, this may look like those described in the Table.

h. The scope of the Vendor Assessment project will determine the work effort involved in developing requirements

Teaching Tip
Provide this example, a focused assessment of a Laboratory solution, for example, would involve a narrower set of requirement than a full EHR and Revenue Cycle evaluation.

i. It may be helpful to start with a predefined list of requirements and validate those against your existing workflows
j. Colleagues who have been through similar efforts may be able to provide sample requirements
k. An organization may also gather requirements from an external source

Teaching Tip
Provide the examples, the Health Resources and Services Administration (HRSA), for example, offers a number of resources to consider including EHR system requirements.

l. In large-scale efforts it is not unusual to seek out the services of a consulting partner to help manage some of the key steps of a Vendor Assessment
m. Consultants often have libraries of requirements that they can leverage as part of their work
n. Regardless of the source of the requirements it is always recommended to validate these with the operational areas
o. This not only ensures the requirements are correct, but it can be an important step in the user engagement process as well

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Develop and Submit RFI/RFP

1. A Request for Information (RFI) is generally used to gather initial information about a vendor and solution offerings and may be used to qualify certain vendors to participate in further analysis
   a. The RFI is often used as a precursor or in conjunction with more formal requests such as a Request for Proposal (RFP)
   b. Request for Tender (RFT) or Request for Quotation (RFQ)
   c. RFQ oftentimes used by the government when the product is approved for purchase, but the local authority must spend the money to purchase and install the software
   d. An RFT is usually an open invitation for suppliers to respond to a *defined* need as opposed to a request being sent to selected potential suppliers
   e. An RFP is generally considered a more formal document of solicitation made, often through a formal and structured bidding process
   f. An RFP may be issued by an agency or company interested in procurement of a product, service, or other valuable asset
   g. In the case of a federal or state agency the RFP may be posted to a procurement Web site
2. The use of an RFI or an RFP offers several benefits. An RFI/RFP
   a. Informs vendors that an organization is looking to purchase products and/or services and encourages them to participate
   b. Requires the organization to specify what it proposes to purchase. If the requirements analysis has been prepared properly, it can be incorporated quite easily into the Request document (see below)
   c. Alerts vendors that the selection process is competitive
   d. Allows for wide distribution and response
   e. Ensures that suppliers respond factually to the identified requirements
   f. Follows a structured evaluation and selection procedure, so that an organization can demonstrate impartiality—a crucial factor in public and private sector procurements
   g. May be used as part of future contract negotiations

Teaching Tip
Refer to the Table which shows a sample of RFI/RFP outline.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Identify

1. During the Identify stage each vendor's eligibility for further participation is determined and the vendor finalists are identified
   a. The RFI/RFP may have been sent to a large number of vendors
   b. The goal is to limit the field to three to five qualified vendors for the upcoming and more resource-intense Evaluation phase
   c. A review of the RFI/RFP responses is conducted and inclusion criteria are established
2. Quantitative and qualitative analyses are conducted on the RFI/RFP responses, including the functional and technical requirements
3. Eliminating vendors from the process can be difficult but should be conducted with transparency and open communication
   a. Once the decision to eliminate a vendor has been made the vendor should be notified verbally and through a formal written response
   b. Vendors may be holding resources in preparation for demonstrations and should have the opportunity to re-deploy those resources should they not be invited to demonstrate their solution

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Evaluate

Teaching Tip
Provide the information, during the Evaluation phase the remaining field of vendors and solutions are looked at more closely. During this phase, vendor demonstrations, site visits, and reference calls may occur to further inform the team and identify the vendor of choice.

1. Demonstrations
    - **a.** Conducting demonstrations is a significant investment in time and resources for the organization and vendors
    - **b.** When conducting demonstrations it is important to strike a balance between the organization's need to objectively evaluate each vendor and the vendors' desire to show the best features of their product
    - **c.** All of this needs to be considered in the context of time and resource availability as well as competing priorities for both the organization and the vendor
    - **d.** It is recommended to establish demonstration dates very early in the process; even before final vendors are known
    - **e.** Depending on the size of the effort and resources demonstration dates should be set, rooms reserved, and communication to hold the dates delivered to vendors in the RFI/RFP
    - **f.** It is important that the demonstrations are fair for all participants
    - **g.** Where possible the same or similar facility should be used at the same time of day for the same duration and with a consistent list of participants
    - **h.** This level of rigor is required to provide an "apples to apples" comparison of demonstration results
    - **i.** Scripts or scenarios developed by the organization are often used to help guide the demonstration and to capture quantitative and qualitative data for evaluation
    - **j.** Having process-oriented scripts that highlight key system requirements provide an opportunity to see how the system is used to achieve organizational goals
    - **k.** Scripts for clinical systems should be oriented around the patient experience and care delivery
    - **l.** It is a common mistake to over engineer the script which makes it challenging for the vendor to demonstrate to an overly prescriptive process and hard for participants to evaluate
    - **m.** Rather high-level scripts can be developed that guide the vendor, allow for some flexibility, and provide a mechanism to capture quantitative and qualitative data
    - **n.** The US government's Web site offers sample demonstration scripts
2. Site visits
    - **a.** Site visits are generally conducted with a limited number of organizations due to the commitment of time and expense for both the host facility and the organization considering the solution
    - **b.** It is important for site visits to be planned in advance with specific goals and objectives identified
    - **c.** Site visits are time limited and vary in duration based on the extent of the solution being considered
    - **d.** Vendor participation in site visits varies as does the number of participants
    - **e.** In general, it is best to keep the group small
    - **f.** It is important to be inclusive with good representation from key stakeholders
    - **g.** The primary objective is to see the solution deployed in an operational environment and to hear direct and candid feedback from the host facility
    - **h.** Typically, a site visit agenda will include the following
        - **i.** Introduction and Overview
        - **ii.** Solution Discussion
        - **iii.** Facility Tour
        - **iv.** Questions and Answers
    - **i.** The introduction and overview is intended to introduce the host site and visitors to each other and to reiterate the goals and objectives of the visit
    - **j.** A solution discussion typically follows, which describes the host organization's experience with the solution from the beginning
    - **k.** This discussion should include the
        - **(1)** Issues the organization was looking to resolve
        - **(2)** Decision process used to identify the selected vendor
        - **(3)** Implementation of the solution
        - **(4)** Relationship with the vendor and whether or not expected benefits have been achieved
    - **l.** The mix and number of participants are governed in a large part by the scope of the solution being considered
    - **m.** Key stakeholders should be well represented
    - **n.** It is recommended for the participants to debrief immediately following the site visit and not wait for the return home
    - **o.** Debriefing together and documenting observations immediately ensure that the team accurately captures their thoughts
    - **p.** Observations related to the workflow integration as well as general observations about the host facility are important to document
    - **q.** When multiple site visits occur and time passes it can be difficult to remember details from facility to facility
3. Reference calls
    - **a.** Reference calls should be conducted in order to appreciate the perspective of customers that have successfully implemented the vendor solution
    - **b.** When requesting references it is important to find organizations that are as similar as possible so that a comparison can be completed

   c. It is recommended that at least three reference calls are conducted
   d. References are completed with those organizations that the vendor has provided as a qualified reference
   e. A reference call questionnaire should be developed so that the same questions are captured for each reference

4. Due diligence
   a. Due diligence refers to a process of further and deeper investigation of a company prior to contract signing
   b. Much of the information required to support due diligence should have been requested in the RFI/RFP
   c. In some instances, it may be necessary to engage a third party to conduct due diligence and to more thoroughly investigate the financial status of a potential vendor partner
   d. The quantitative and qualitative data collected throughout the process is used to support and inform the vendor of choice decision
   e. As with most major decisions, however, there is a need to do a “gut check”
   f. If, despite the data collected the vendor does not “feel” like the right partner during the selection and pass the teams gut check it is unlikely that they will meet the organization’s needs once a contract is signed
   g. While the data is helpful in the end the instincts of the team and leaders involved in the process is the most valid indicator of future success
   h. Guiding Principle #4—Use the Data; Trust Your Gut
   i. A major deliverable of the Evaluation phase is the Summary Analysis
   j. The Summary Analysis brings together data from all parts of the methodology in a clear and concise format that is ready for executive review

Teaching Tip
A sample Summary Analysis is provided in Figure 20.3, Sample Summary Analysis.

5. Partner
   a. In a well-structured vendor selection process the winner or “Vendor of Choice” often emerges as the clear answer
   b. In the past, some organizations elected to enter into contract negotiations with multiple potential solution providers in order to increase leverage and provide for a more competitive bidding environment
   c. In practice, however, this strategy seldom achieves the intended results and more often creates unnecessary tension between the organization and its potential future business partner
   d. Guiding Principle #5—Make a Commitment
   e. As in any relationship, once a partner is identified, it is important for both parties to make a commitment to each other’s success
   f. Contract negotiations may begin as soon as the preferred vendor is identified
   g. At this stage it is common for organizations to include legal representatives who are familiar with health information technology contracts as part of the team
   h. In some cases early planning activities will occur in parallel with contract negotiations
   i. Data gathered throughout the analysis may be used to inform planning and contract discussion
   j Some organizations, for example, may include the vendor response to the requirements as part of the contract in order to hold the vendor accountable for their answers
   k. Stakeholder communication is vital throughout the life cycle of a vendor selection
   l. Oftentimes the team will be expected to provide a summary of the analysis and current status
   m. The audience for these presentations can range all the way from frontline staff to the organization’s board of directors or creditors
   n. Effective communication and presentation skills are essential
   o. The team should anticipate questions and be prepared to respond with short notice to any and all stakeholders
   p. A well thought out communication plan during the selection effort will set the stage for ongoing communication during the planning and implementation phases

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY AND BEST PRACTICES

- In conclusion, it is immense responsibility to lead or participate in the selection of a new vendor partner for an organization
- Following a data-driven and evidence-based Vendor Assessment Methodology provides the opportunity for a thoughtful and objective analysis of the vendor marketplace
- The Key Steps of the Vendor Assessment Methodology are
    - Strategy
    - Define
    - Identify
    - Evaluate
    - Partner
- Remember to consider and apply the Key Guiding Principles throughout the life cycle of the Vendor Assessment:
    - Manage the Change; Communicate
    - Maintain and Document Objectivity
    - Think Process; Not Department
    - Use the Data; Trust Your Gut
    - Make a Commitment

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe an approach to evaluate the vendor marketplace for health information technology solutions
- Discuss the evolution of the healthcare technology marketplace
- Distinguish the custom development or "build" approach from the purchasing of commercially available solutions or "buy" approach
- Identify two or more criteria that may be used to differentiate one vendor from another
- List the Key Guiding Principles of a Vendor Analysis Methodology

Teaching Tip

Ask the students to define the keywords

- Best of breed
- Change management
- Return-on-investment (ROI)
- Request for Information (RFI)
- Request for Proposal (RFP)
- Single vendor

CHAPTER REVIEW QUESTIONS

Question 20.1: What are the key steps of conducting a Vendor Assessment?

a. Strategy, define, identify, evaluate, and partner

b. Develop an RFI and RFP

c. Develop the assessment and evaluation together

d. Develop a strategy only

Question 20.2: What are the Key Guiding Principles throughout the life cycle of Vendor Assessment?

a. Write a good RFI and RFP

b. Understand your requirements

c. Manage the Change; Communicate, Maintain and Document Objectivity, Think Process; Not Department, Use the Data; Trust Your Gut, and Make a Commitment

d. There are no guiding principles—you need to trust your gut

Question 20.3: What are at least two criteria that can be used to differentiate one vendor from another?

a. Among others, there are business, technical, and solution differentiators that should be considered as part of the Define phase of a vendor assessment

b. The way their salesmen/saleswomen dress

c. There will be differences in their marketing brochures

d. There will be differences in their RFP response on defining the workforce

Question 20.4: What is the difference between "build" versus "buy"?

a. Build is when the application is developed in-house as the "build" approach was necessary at a time when commercial options were limited; Today competition has allowed purchasing or buying a solution (this is the "buy" solution)

b. There is no difference. Buy is the purchase of commercial off the shelf (COTS) that is made for resale. The end products of both end up the same

c. The build is less expensive and requires no in-house staff

d. The buy is most expensive and requires no in-house staff

Question 20.5: What is an approach to evaluating the vendor marketplace?

a. The Vendor Assessment Methodology

b. Attending vendor demonstrations

c. Attending government-sponsored seminars

d. Attending professional organization summits

Question 20.6: What are some reasons for assessing the vendor market?

a. New or pending regulatory requirements unmet by current vendor, such as meaningful use or ICD10, current solution outdated, no longer supported (e.g., application retired), changing business needs not met by current solution, merger with another institution on a different platform, new enabling technology required to support improved care delivery/practice, leadership decisions to change or introduce new technology, current solution no longer meets business/clinical requirements, such as personalized healthcare, and poor service or instability of current vendor

b. A member of the institutional board heard that one vendor product was the best?

c. Everyone in the marketplace is changing

d. None of the above

Question 20.7: Functional requirements are defined as ___________?

a. Functional requirements are defined as those features that determine how the technology will function

b. Functional requirements are defined as those features that define computer–human interface

c. Functional requirements are those that define how the computer will integrate with other computers

d. Functional requirements refer to those features and functions that support workflow of end users

Question 20.8: Technical requirements might include:

a. Technical requirements might include standards only

b. Technical requirements might include how the computer can interface with HIEs

c. Technical requirements might include interface to laboratory systems, supports Window active directory, ability to send and/or receive HL7 messages, and complies with HIPAA technical security standards

d. Technical requirements include the ability to integrate with other vendor solutions only

Question 20.9: True or False: A focused assessment of a Laboratory solution would involve a narrower set of requirement than a full Electronic Health Record and Revenue Cycle evaluation.

Question 20.10: What is an RFP?

- **a.** A request for the business costs of implementing a computer system
- **b.** A Request for Proposal
- **c.** A Request for Paper describing a company's solutions
- **d.** A Request for Policy

ANSWERS AND EXPLANATIONS

Question 20.1: (a) Strategy, define, identify, evaluate, and partner are the key steps in the Vendor Assessment Methodology.

Question 20.2: (c) The Key Guiding Principles throughout the life cycle of Vendor Assessment are: Manage the Change; Communicate, Maintain and Document Objectivity, Think Process; Not Department, Use the Data; Trust Your Gut, and Make a Commitment.

Question 20.3: (a) Among others, there are business, technical, and solution differentiators that should be considered as part of the Define phase of a vendor assessment.

Question 20.4: (a) Build is when the application is developed in-house as the "build" approach was necessary at a time when commercial options were limited; Today competition has allowed purchasing or buying a solution (this is the "buy" solution).

Question 20.5: (a) The Vendor Assessment Methodology.

Question 20.6: (a) New or pending regulatory requirements unmet by current vendor, such as meaningful use or ICD10, current solution outdated, no longer supported (e.g., application retired), changing business needs not met by current solution, merger with another institution on a different platform, new enabling technology required to support improved care delivery/practice, leadership decisions to change or introduce new technology, current solution no longer meets business/clinical requirements, such as personalized healthcare, and poor service or instability of current vendor.

Question 20.7: (d) Functional requirements refer to those features and functions that support workflow of end users.

Question 20.8: (c) Technical requirements might include: "Ability to interface to Laboratory system," "Supports Window Active Directory," "Ability to send and/or receive HL7 messages," "Complies with HIPAA Technical Security standards."

Question 20.9: True. A focused assessment of a Laboratory solution would involve a narrower set of requirement than a full Electronic Health Record and Revenue Cycle evaluation.

Question 20.10: (b) A Request for Proposal.

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Nurse Scheduling and Credentialing Systems

• OBJECTIVES

1. Describe the history of staffing and current scheduling gaps.
2. Identify the requirements for an intelligent integrated workload management system (WMS).
3. Discuss the new era of healthcare reform and the challenge to staffing and credentialing.
4. Identify challenges for nursing informatics in the future.

• KEY WORDS

Accountable care act
Credentialing
Electronic Health Records (EHR)
Patient acuity systems
Predictive analytics
Safe staffing mandates
User centered staffing
Workload Management Systems (WMS)

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: How would you use a computer to determine staffing a nursing unit? How would you use a computer for staffing a nursing unit? Are you familiar with any staffing software? Why is it important to determine patient acuity to determine staffing?

For a WIIFM statement, say to the class, "Historically nurse scheduling was a function of assigning personnel on an equitable basis. These tasks were paper and pencil schedules with little accommodation for variation. The number of personnel assigned to a unit was based on historical patient occupancy rates. In the early 1970s, several commercial systems containing a patient acuity system were available for use. As Electronic Health Records developed, new applications for scheduling nurses became available. In addition to the scheduling functions, software began to provide workforce management functions. There has been a demand to provide minimum staffing levels and some state laws mandates these levels. In today's environment, there is an increasing need to prove value for nursing care and to use nursing skill to provide improved patient outcomes, manage costs of patient care, and ensure that the appropriate nursing skill is provided through credentialing techniques. This chapter will address some of the issues, and provide a call to action to provide integrated evidence-based systems for nursing's use." As a nurse, it is important to understand staffing, costs, use of the EHR, as well as patient acuity.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites related to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   - **a.** Historically, nursing work commitment was a function of employment
     - **(1)** The nurses agreed to work required pattern on weekends
     - **(2)** And rotating shifts
   - **b.** The function of nurse scheduling was to
     - **(1)** Try and provide an equitable number of nurses for an assigned shift
     - **(2)** And honor special requests if at all possible
   - **c.** Special requests were pieces of paper (or later sticky notes) handed to the nurse manager or schedule coordinator and the nursing schedules were completed using paper and pencil
   - **d.** Allowing the staff nurses to self-schedule was too complicated to manage
   - **e.** The nursing supervisor accomplished shift changes in staffing for callouts, overstaffing and understaffing
   - **f.** Temporary agency nurses were utilized to provide required patient care
   - **g.** The use of agency personnel doubled the cost of nursing care
   - **h.** In the early 1960s a nursing workload measurement system was introduced
   - **i.** The terms used to differentiate the number of nurses required to provide optimal care to a group of patients include
     - **(1)** Nursing Workload
     - **(2)** Nursing classification
     - **(3)** Patient acuity
     - **(4)** Nursing intensity
   - **j.** By the 1980s a number of computerized systems were developed to assist in the measurement of nursing workload
   - **k.** Patient profiles, nursing task documents, and critical indicators of care were used to develop these measurements
   - **l.** Early systems used time and motion measurement studies based on activities of daily living, how long to
     - **(1)** Bathe
     - **(2)** Feed
     - **(3)** Ambulate a patient
   - **m.** Some of the early computerized scheduling and nursing workload systems included
     - **(1)** GRASP
     - **(2)** Medicus
     - **(3)** PRN
     - **(4)** ANSOS
     - **(5)** Van Slyke
     - **(6)** The Navy Workload Management System

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Gap Between Present Reality and the Needs of the New Healthcare System in Staffing

1. Overview
   - **a.** Provide the following introductory information, today, the predominant mode of scheduling and staffing continues to be on paper via spreadsheets and other similar methods
     - **(1)** Using this outdated method of staffing means critical employee information is likely kept in many disparate locations and databases
     - **(2)** Without database integration, a Workload Management System (WMS) is not possible
     - **(3)** An automated WMS should provide at a minimum
       - **i.** Licensure information
       - **ii.** Certification skills information such as PALS, ACLS
       - **iii.** Current contact information
       - **iv.** Employee work preferences
       - **v.** Competency to “float” or work on a variety of units
       - **vi.** Ability to assess and match the competencies of the nurse with the needs of the patient
       - **vii.** Prospective and predictive analytics for effective staffing
       - **viii.** Integrate quality metrics with staff outcomes
2. Paper-based Systems
   - **a.** Outdated staffing and scheduling methods also come with a significant financial cost
   - **b.** Scheduling managers, risk assigning overtime hours to a nurse who has worked more than 80 hours in a two week pay period
   - **c.** This can create poor financial outcomes for the organization
   - **d.** There is a growing body of evidence that nurse fatigue poses a serious threat to patient safety
   - **e.** Many states have implemented safe staffing requirements limiting the number of consecutive hours a nurse can be on duty
   - **f.** It is possible to aggregate and integrate information into a WMS that can be integrated with
     - **(1)** Scheduling and staffing
     - **(2)** Human resource
     - **(3)** Financial
     - **(4)** Quality
     - **(5)** Other systems
   - **g.** Workforce management technology makes it possible to embed alerts and reminders based on data and evidence integrated from many sources that enable organizations to
     - **(1)** Move from making staffing decisions based on pure opinion
     - **(2)** Decisions based on data and evidence
3. Assessing the needs of the patient
   - **a.** The ultimate goal of staffing and scheduling should be to
     - **(1)** Match the needs of the patient
     - **(2)** With the abilities of the nurse in order to create excellence in clinical outcomes and operational excellence

- **b.** Staffing by ratios or matrixes does not capture the unique needs of the individual patient

Teaching Tip

Use the following, For example, the needs of an 80 year old with pancreatitis differ greatly from that of a 40 year old with the same diagnoses. The 80-year-old needs help with ambulation, has a complicated medication regime, and has a risk of falls and pressure ulcers.

- **c.** Without clearly knowing the needs of the patient, staffing systems fail to keep the needs of the patient as the center focus of staffing and scheduling
- **d.** Now acuity systems
    - **(1)** Can pull information directly from the medical record to calculate hours of care
    - **(2)** Eliminating the variation between nurses in the manual system
- **e.** This integrated technology also saves significant time on the scheduling process as a whole

4. Assessing and matching the competencies of the nurse

- **a.** Nurses have varying
    - **(1)** Skills
    - **(2)** Experience
    - **(3)** Competency
    - **(4)** Abilities
    - **(5)** Preferences to care for different types of patients
- **b.** In traditional staffing systems, there often is not much information available about the nurse to effectively match those competencies with the needs of the patient
- **c.** Expiration dates for licensure, required certifications and other expiration dates can sometimes be found but are
    - **(1)** Often stored in another system, such as the human resources system
    - **(2)** And are not communicated to staffing managers or those responsible for matching patients to caregivers
- **d.** Certifications might be found in information stored
    - **(1)** On the unit
    - **(2)** In a learning management system
    - **(3)** That is also kept separate from
    - **(4)** And not communicated to, the staffing system
- **e.** Without a fully integrated and dynamic system that makes this information available at the point of assignment of the nurse to the patient
    - **(1)** The scheduling process happens without the necessary information to make a good assignment
- **f.** Bad assignments
    - **(1)** Can be detrimental to an organization's bottom line
    - **(2)** Not just from a safety standpoint
    - **(3)** But also from a quality care measurement standpoint
- **g.** Manually identifying critical employee information stored on separate systems
    - **(1)** Takes time
    - **(2)** Can be difficult
    - **(3)** Making it impossible to accomplish in a timely manner
- **h.** If efficiency is the goal
    - **(1)** Scheduling managers, who are often nursing department leaders
    - **(2)** Should be spending less time on staffing and scheduling
    - **(3)** And more time on patient care
- **i.** Evidence is mounting about the effect nurse fatigue has on patient care

Teaching Tip

Provide the following example, the likelihood of a nurse making an error is three times higher after working a shift lasting more than 12 hours.

- **j.** More hours of RN time spent on direct patient care results in a shorter length of patient stays and fewer failures to rescue
- **k.** For each full-time equivalent (FTE) nurse per patient day, the absolute risk of mortality decreases by 0.25 percent
- **l.** Intelligent staffing systems
    - **(1)** Track the amount of hours a nurse has worked
    - **(2)** Sends alerts and stops to prevent scheduling a nurse approaching excessive hours
    - **(3)** Which will create patient safety problems
- **m.** Costs can be reduced by systems that alert scheduling managers to prevent unnecessary overtime
- **n.** These systems can also ensure that equitable assignments are made by
    - **(1)** Balancing the workload of all the people in a unit
    - **(2)** Using the information from the patient classification system
    - **(3)** Nurse competencies

Teaching Tip

Provide this example, it is not uncommon to see new nurses given difficult and heavy assignments while experienced nurses are underutilized and not assigned to the patients they can care for best.

- **o.** Nurse satisfaction is tightly tied to assignments
- **p.** Without data about the competencies of the nurse to effectively make equitable and safe assignments
    - **(1)** Nurses will more than likely become less than satisfied over time
- **q.** Without question nurses who are unhappy effect patient satisfaction and engagement
- **r.** Nurse turnover is an expensive item in the budget
    - **(1)** With replacement costs amounting to as much as 250 percent of their salary
- **s.** It also accounts for major quality issues
- **t.** Patient assignments are extremely important when the goal is to
    - **(1)** Generate the best quality and financial outcomes
    - **(2)** Best nurse satisfaction and retention rates

5. Prospective/predictive analytics
    - **a.** Effective staffing and scheduling depends on information from a variety of sources such as
        - **(1)** Projected admissions
        - **(2)** Acuity of patients
        - **(3)** Expected length of stay
    - **b.** By integrating and analyzing information from the sources of data that affect staffing and scheduling
        - **(1)** It is possible to predict staffing needs
        - **(2)** Create better and more effective processes
    - **c.** The amount of associated staffing information that is collected and stored is very large
    - **d.** With the modern technology
        - **(1)** That is designed to analyze large data sets
        - **(2)** We now have the opportunity to turn that data into predictable and actionable information
6. Integrating quality metrics with staffing outcomes
    - **a.** With the ability to
        - **(1)** Integrate quality data from several sources
        - **(2)** Pull it into a staffing system
        - **(3)** It is now possible to integrate quality data with the staffing process
    - **b.** Technology
        - **(1)** Allows us to see in advance what kind of nursing care a particular patient needs
        - **(2)** Based on an assessment pulled from the documentation in the medical record
    - **c.** By integrating all of this data safer, more effective care is provided
    - **d.** In today's market, where quality standards are given equal measure against financial goals
        - **(1)** The clinical and financial sides of the business must work together
        - **(2)** Or long-term sustainability will suffer

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The New Era of Healthcare and the Challenge of Staffing

1. Overview
    - **a.** The multiple influences of quality performance initiatives, performance targets for patient quality, nurse satisfaction, budget/financial controls and unanticipated events reflect the ever increasing complexity of the healthcare system now and in the future
        - **(1)** The principles and realities of complexity and complex adaptive systems provide an excellent framework upon which to determine strategies and processes in a rapidly advancing digital world
        - **(2)** The recognition of the unpredictable nature of scheduling and staffing as normative, and the importance of the multiple relationships among nurses, staffers and informaticists supporting computerized systems can only enhance the effectiveness of future systems
    - **b.** Among the top concerns for nursing executives today, are patient satisfaction/patient experience, quality of care, patient safety, and controlling costs
        - **(1)** Advancements in technology have fostered the creation of more robust EHR solutions, which is giving providers more comprehensive, real-time access to information about a patient's healthcare status
        - **(2)** This information has vastly improved patient safety, and ultimately yielded more long-term positive patient outcomes
    - **c.** The pervasive use of EHRs has been accelerated by the passage of the American Reinvestment and Recovery Act (ARRA) in 2009
        - **(1)** Commonly known as the "economic stimulus," the ARRA contained provisions under the Health Information Technology for Economic and Clinical Health (HITECH) Act establishing a foundation for every American to benefit from an EHR as part of a modernized, interconnected, and vastly improved system of care delivery
        - **(2)** Specifically, Title IV, Division B of the HITECH Act establishes incentive payments under the Medicare and Medicaid programs for EPs and EHs that meaningfully use Certified EHR Technology (CEHRT)
        - **(3)** This incentive provision is directly responsible for the fundamental industry shift to emphasize and measure quality care standards
        - **(4)** The HITECH Act of 2009 has created a fundamental shift in priority towards prevention and community, which is supported through the emphasis on quality care goals tied to more positive patient outcomes
    - **d.** Achieving long-term financial sustainability in this new marketplace will be impossible for organizations tied to outdated and inefficient workforce scheduling, staffing, and assignment systems
        - **(1)** There is an acute need to recognize that a transformational workforce is necessary to meet the needs of the next generation of healthcare
2. Moving from volume to value
    - **a.** For the last 50 years the healthcare industry adhered to a simple, easy to measure, fee-for-service model
    - **b.** The focus is moving toward a value-based model that relies heavily on metrics tied to high quality outcomes
    - **c.** Technology such as the EHR can play a significant role in ensuring patients
        - **(1)** Are not only receiving the highest quality care
        - **(2)** But the right care and that information can be linked to a WMS
    - **d.** The average portion of a health system's operating budget devoted to human resources or labor is 54.2 percent

3. From site based to the continuum of care focus
   a. Historically, our healthcare system has been organized around a single site of care
   b. Without a way to track a patient's progress before or after that single site visit, certain quality measures, such as care consistency, were very difficult to achieve
   c. Before EHRs, the ability to follow and integrate the care needs of a patient throughout their healthcare journey was difficult at best
   d. Without a comprehensive workforce management strategy, ensuring consistency of care across the continuum becomes equally as challenging
   e. With both of these components tied directly to patient satisfaction and care quality metrics, it makes perfect business sense to invest in the technology that will enable complete integration of care needs and staffing across a patient's entire journey
   f. A coordinated workforce plan allows for scheduling across all units, departments and facilities, regardless of location
   g. Without this coordination the risk for patients and organization costs increase
   h. Implementing solid staffing practices across entire organizations is critical
   i. At the root of every staffing best practice is the need for accurate, timely information about both patients and caregivers
   j. When staffing decisions are backed by solid data and based on actual patient care needs and staffing skill sets, patient outcomes improve and labor costs are controlled
   k. While staffing is a complex, dynamic, and continuous process, using data driving staffing standards and best practices can lead to staffing plans that consistently match the right caregivers with the right patients, no matter where they are on their healthcare journey
4. Implementing coordinated care through intra-professional teams across the continuum
   a. The traditional model of staffing has been to assign nurses in isolation without consideration of the complete care team made up of hospitalists, intensivists, social workers, care coordinators, Advanced Practice Nurses, and physicians
   b. However, there is now evidence to support that staffing and caring for patients in silos is not as effective as an integrated workforce management strategy across the continuum of care
   c. The WMS entails storing, managing and maintaining all employee information in a single, fully integrated suite of solutions, replacing disparate systems and incomplete information with a more complete organizational workforce management picture

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Utilizing Data and Best Practices Based on Evidence to Create Better Outcomes

1. Overview
   a. Evidence-driven protocols are now widely accepted as a means of directing the work of the physician and other clinicians
      (1) In today's market, it is expected that staffing needs be based on data and evidence
      (2) Staffing and patient care needs are deeply entwined with a hospital's bottom line, and accurate, effective nurse staffing and acuity strategies can help health systems reach their patient care and financial goals
      (3) Pairing nurse talents, skills, and experience with specific patient needs through acuity-based staffing, hospitals are able to maintain low readmission rates, deliver exceptional patient care and remain financially successful
   b. Nurse staffing and scheduling is a complicated process; from analysis of nurse experience and skill sets to availability and budgeting needs, a great deal of work goes into coordinating staffing plans
      (1) Acuity-based staffing models make it possible to evaluate actual patient care needs in order to make data-driven decisions
   c. Nurse workload, shift turnover and inefficient patient matching can directly impact patient care in hospitals
      (1) Researchers examined data from 197,961 admissions and 176,696 nursing shifts at an academic medical center and found patient mortality increased as unit shift hours rose and nurse staffing levels dropped
      (2) It has been found that patient deaths cost hospitals, approximately $20 billion every year
   d. According to a 2013 study in Health Affairs, staffing is the single most significant factor in reducing readmissions
      (1) Health systems with higher nurse employment had a 25 percent lower chance of receiving penalizations for readmissions through HRRP than those that had lower nurse staffing levels
      (2) Essentially, the higher nurse workloads are and the less nurse managers and staffing coordinators utilize acuity when assigning shifts, the more at-risk patients are for being readmitted
2. Moving to user-centered staffing
   a. Nurse burnout, retention and satisfaction directly affect the hospital's bottom line
   b. Nurses put a great stake in being able to treat all of their patients safely, effectively and compassionately, and they feel the impact physically, emotionally and mentally when the workload is not balanced
   c. So when nurses aren't matched correctly with their patients—either they don't have the necessary qualifications to provide adequate care or have too much work for the number of patients they have to treat—they can quickly become dissatisfied with their jobs
   d. When hospitals have accurate staffing, nurse burnout, and dissatisfaction can drop significantly

   - **e.** Staff turnover is costly
   - **f.** Technology that empowers nurses to control their own work/life balance is a critical, but important investment for organizations seeking to keep turnover rates low, employee satisfaction rates high, and patient outcomes positive
   - **g.** By placing the decision making process directly on the employee, through user-centered staffing strategies, organizations create a sense of balance for their most critical group of employees
   - **h.** Achieving these objectives can be done, but it requires the use of technology to provide data and evidence for decisions
   - **i.** Without an electronic employee record that integrates all the information needed to do effective staffing in an intelligent record, the challenges of this new healthcare market cannot be met
   - **j.** The gap to get there is significant and must be closed immediately

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Integrated Workforce Management System Requirement for Nursing

1. Overview
   - **a.** In this new healthcare marketplace, it is a real possibility that caregivers will have the opportunity to work across several venues, especially as more organizations merge and consolidate, creating integrated, complete health systems
     - **(1)** For the most part, local and regional staffing pools do a good job of addressing the fluctuating census, however, there is still a need for contingent labor, especially as budgets become tighter and internal resources decline
     - **(2)** As the patient moves throughout the continuum, it is imperative that their medical records travel with them
     - **(3)** It is also equally as imperative that an electronic employee record for caregivers be available so that consistent care can be achieved
     - **(4)** Providing exceptional patient care in today's accelerated environment is dependent in large part on the management of staff resources and tremendous amounts of employee-related information
     - **(5)** The process includes accessing, tracking, managing, and analyzing labor data on demand to enhance the decision-making process
   - **b.** Just as the EHR collects information about the patient from a variety of sources, the WMS does the same for the caregiver
     - **(1)** When data from the EHR integrates with information from the WMS, the goal of excellence in staffing and scheduling can be achieved
     - **(2)** The electronic employee record streamlines workflows that are used each and every day throughout the health system
     - **(3)** That streamlining equates to a more satisfied, cost-effective workforce that is empowered to provide high quality patient care. Implementing a successful, integrated, and intelligent WMS is contingent on several minimal requirements
2. Integration across the continuum
   - **a.** Just as an EHR follows the patient through their journey across the healthcare system, the WMS should follow caregivers throughout their tenure with their health system employer
   - **b.** Employee-related information from throughout the enterprise, including supplemental and contingent staffing sources– can be used to
     - **(1)** Review
     - **(2)** Identify
     - **(3)** Manage
     - **(4)** Maintain processes more effectively for the entire workforce
   - **c.** This strategy makes it possible to
     - **(1)** Eliminate duplicate data maintenance
     - **(2)** Manual processes
     - **(3)** Costly interfaces while increasing information accuracy and efficiency
   - **d.** Integrating employee information into a seamless data flow makes it possible to
     - **(1)** Track trends
     - **(2)** Create forecasts that improve human resource utilization
   - **e.** With this enterprise-wide employee data management strategy, the end result will be heightened efficiency and an improved bottom line
   - **f.** Communication between dispirit systems is critical to evolve the WMS
   - **g.** Techniques used to communicate data between systems includes
     - **(1)** Health Level 7 (HL7) Messaging
     - **(2)** Service Oriented Architecture (SOA) and
     - **(3)** Publish-Subscribe Architecture (Pub-Sub)
   - **h.** Increasing use of data will only increase the need for sharing it among software systems
   - **i.** There are verities of options to consider when building data sets sourced in different software systems
   - **j.** Nursing Informatics needs to understand both the
     - **(1)** Purpose of the data
     - **(2)** Options for making the data available, when and where it is need to allow for the right, and best, choice to be made when the care for the patient requires it
3. Centered on the needs of patients
   - **a.** Staffing and scheduling activities should be focused solely on creating a safe and healing healthcare experience for the patient

  - **b.** In order to accomplish this efficiently and effectively, it is critical that we leverage acuity data and match it with competency data from the WMS

4. Provides actionable information about the caregiver to create safe and fulfilling work
  - **a.** Access to employee related data is important for several reasons
  - **b.** Real-time information regarding
    - **(1)** Active licensure
    - **(2)** Certifications
    - **(3)** Demonstrated competencies are important to ensuring safe, quality patient care
  - **c.** Knowing a nurse's preferences for what type of patient they are best suited to care for can make the difference between a great nurse–patient relationship and a poor one
  - **d.** When this type of information is available for consideration, a better patient match can happen
  - **e.** The history and type of hours worked is also important to
    - **(1)** Monitor potential nurse fatigue
    - **(2)** Excessive overtime
    - **(3)** Fairness of assignments
  - **f.** The process of staffing and scheduling must be based on national scope and standards
  - **g.** When considered as a whole, all of these elements equate to a better working experience overall, which leads to improved morale and a more satisfied workforce
  - **h.** When this information is stored in separate systems, without a way to integrate and communicate between them, scheduling managers are at a distinct disadvantage
  - **i.** A dynamic system that brings all of this vital information together, in real time, is the key to workforce optimization

5. Integrated with quality and financial measures and outcomes
  - **a.** With increasing evidence correlating effective staffing with patient outcomes, it's critical that systems be leveraged that utilize information to support the idea that staffing assignments should provide better outcomes for patients
  - **b.** When more information is accessible regarding patient care needs and the optimal way to deliver that care, the financial realities of healthcare can be balanced with high quality patient care
  - **c.** Financial outcomes can be improved with proactive information about the most efficient way to staff and schedule
  - **d.** Over and understaffing can create unwanted financial outcomes, as well as unwanted quality outcomes
  - **e.** Integrated staffing systems that can provide information about the financial cost of a staffing decision in real time are imperative to achieving long-term financial sustainability in a highly competitive marketplace
  - **f.** With a strong clinical–financial connection, productivity measures are more accurate and include cost-of-shift data
  - **g.** With all of that information available and evaluated before the start of the shift, projected overtime and excessive use of contingent labor can be avoided while patient care needs are met
  - **h.** With real-time productivity information, discrepancies between budget and actual staffing numbers and labor costs are explained with clinically based justification and actual patient need data
  - **i.** With this complete, multidimensional picture of actual patient care needs and the clinical workforce that will meet those needs, organizations can make solid staffing decisions that
    - **(1)** Optimize patient care
    - **(2)** Minimize labor costs
  - **j.** Clinical leaders are able to align their goals, delivering patient care that achieves both
    - **(1)** Positive clinical outcomes
    - **(2)** A healthier bottom line
  - **k.** Systems that can guide the staffing process based on the evidence will provide the beginning level of intelligence needed for a revised business model that depends heavily on excellence in patient outcomes for reimbursement

6. Robust analytical capabilities
  - **a.** With multiple sources of data available to supply an integrated WMS, there are many opportunities to integrate that data with
    - **(1)** Proactive suggestive analytics
    - **(2)** Automatic retrospective reports that will lead to better quality and financial outcomes
  - **b.** Rather than simply pointing out inefficiencies, technology should provide the information necessary to improve efficiencies
  - **c.** Not only is it expensive to deploy more resources than necessary
    - **(1)** It becomes a quality issue if the right resources are not in place
    - **(2)** Which is why it makes good business sense to leverage technology that aligns financial and clinical goals

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Challenges for Nursing Informatics in the Future

1. Overview
  - **a.** Much of the work of nursing informatics has been associated with the patient Electronic Health Record for very good reason
    - **(1)** However, with the advent of additional research on the relationship of staffing to patient outcomes, we must now turn our attention to the nurse/caregiver
    - **(2)** Certain elements, such as competencies and preparedness to manage a particular type of patient, can dramatically impact patient outcomes
    - **(3)** Technology allows us the ability to develop staffing systems that can gather information from many different data sources and match the needs of the patient with the competencies of the nurse

        (4) In the past, staffing has been the underrepresented frontier of technology development. In this new quality driven, highly competitive marketplace, we need to focus attention and skill development from nurses in informatics in order to achieve operational excellence

2. Create awareness that the healthcare worker is the keystone for excellence in outcomes
   - **a.** Staffing and scheduling is a very complicated process that
      - **(1)** Must synthesize many unrelated variables into a coherent understanding
      - **(2)** Creates excellence in patient outcomes
   - **b.** Without effective staffing, the elegant work of the EHR becomes wasted
   - **c.** Without the right staff to apply the care requirements dictated by the EHR, the patient will not benefit
   - **d.** Given the breadth of most health systems, and likely its sizeable number of employees on staff, it is impossible to adequately synthesize all the necessary employee qualification information without the aid of holistic, integrated technology
   - **e.** An effective, integrated electronic staffing and scheduling system is achieved when information from the WMS integrates with information contained in the patient's medical record
   - **f.** Staffing and scheduling is a body of knowledge not readily available to the clinical nurse and to nursing informatics practitioners who do not have the background in management
   - **g.** Learning staffing operations is usually an "on the job" training experience, and doesn't include access to the operational literature and available evidence that supports excellence in outcomes
   - **h.** Without that knowledge, it is difficult for the nursing informaticist to understand and advocate for integrated electronic staffing systems that include an electronic employee record

3. Elevate the needs of the caregiver to ensure support for the individual as a professional whole
   - **a.** Collectively, all of the information on the WMS is necessary to provide the best staffing
   - **b.** However, in addition to
      - **(1)** Supporting the pursuit of quality patient outcomes
      - **(2)** There must also be support for the caregiver
   - **c.** There is increasing evidence available about the
      - **(1)** Impact of nurse fatigue
      - **(2)** Posttraumatic syndrome
      - **(3)** Compassion fatigue
      - **(4)** Burnout

Teaching Tip

Provide the examples, it is normal for a nurse to feel grief when a patient dies. However, if the nurse isn't supported emotionally, the ability to work through the grief will be hampered. In addition, nurses who make mistakes due to nurse fatigue from over scheduling often face guilt over their error. In reality, the root cause for the error was failure to schedule based on the evidence. Had an electronic employee record been utilized, it would have predicted this kind of untoward outcome.

   - **d.** To support efforts for making the WMS ubiquitous, it helps to point out that an integrated and holistic staffing and scheduling solution that includes an WMS that can send out
      - **(1)** Alerts
      - **(2)** Reminders
      - **(3)** Hard stops to ensure that nurses work in a healthy environment rather than a toxic one that brings harm to patients, and ultimately the organization

4. Expand the focus of Nursing informatics to include the electronic health record and develop workforce systems that are robust and real time
   - **a.** WMS continues to grow and evolve
   - **b.** The challenge today is that we are finding that while we have the critical employee data
      - **(1)** It is stored across many disparate databases
      - **(2)** That are not integrated with each other
   - **c.** Thanks to what we know about the technology that runs the EHR
      - **(1)** We can develop an intelligent staffing and scheduling system
      - **(2)** That leverage multiple databases of critical employee information
      - **(3)** To ensure the most effective staffing assignments
   - **d.** The implication is that schools of nursing, and Informatics departments in healthcare organizations must accept the challenge
      - **(1)** To do for our workforce
      - **(2)** What we have done for the patient
      - **(3)** Use technology to ensure optimal outcomes
   - **e.** As we consider
      - **(1)** The role technology plays in how we learn to care for patients from a clinical standpoint
      - **(2)** It is equally important that we consider the role technology plays in learning about the characteristics of nurses
   - **f.** In today's business climate, these two elements are inextricably linked
   - **g.** An understanding of the nurse–patient relationship
      - **(1)** Needs to be part of the knowledge base of nursing informatics
      - **(2)** If we are also going to understand the clinical knowledge associated with patient care

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- We are poised on the edge of incorporating the
  - Evidence
  - Data
  - Information about the nurse/caregiver into healthcare in the same manner that we have done with the EHR
- With the advent of the WMS for caregivers
  - The opportunity to match the needs of the patients
  - With the competencies of the nurse are possible within a data/evidence driven system
- Within an intelligent electronic staffing and scheduling system that integrates information about the patient from the EHR with information about the nurse/caregiver in the WMS
  - It is now possible to balance the workload of the nurse
  - And match the needs of the patients with the nurse/caregiver
- The opportunity to retrospectively evaluate staffing through analysis of the large data sets that the process of staffing generates to improve quality and financial outcomes is vast
- The goal of developing predictive models to more accurately predict
  - Patient census
  - Acuity
  - Matching that data with the availability and the competency of the nursing/caregiver staff is enormous
- We are now on the edge of effectively developing and utilizing technology that can provide information to optimize the integration of the nurse with the patient effectively

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe the history of staffing and current scheduling gaps
- Identify the requirements for an intelligent integrated workload management system (WMS)
- Discuss the new era of healthcare reform and the challenge to staffing and credentialing
- Identify challenges for nursing informatics in the future

Teaching Tip

Ask the students to define the keywords

- Accountable Care Act
- Credentialing
- Electronic health records (EHR)
- Patient acuity systems
- Predictive analytics
- Safe staffing mandates
- User centered staffing
- Workload management systems (WMS)

CHAPTER REVIEW QUESTIONS

Question 21.1: What is a WMS?

a. A Washington Managed Rules Survey
b. A Workload Management System
c. A Wisconsin Managed Financial System
d. None of the above

Question 21.2: What might a Workload Management Systems (WMS) might include?

a. Licensure information, Certification skills information such as PALS, ACLS, Current contact information, Employee work preferences, Competency to “float” or work on a variety of units, Assess and match the competencies of the nurse, Use perspective and predictive analytics for effective staffing, and Integrate quality metrics with staff outcomes
b. Only the schedule the nurse would like to work
c. Only certification and licensure are needed
d. None of the above

Question 21.3: Effective staffing and scheduling depends upon ___________?

a. The shifts that the nurse wants to work
b. The competencies that the nurse has to work
c. Information from a variety of sources such as projected admissions, acuity of patients, and expected length of stay
d. (a) and (b) only

Question 21.4: True or False? It is never possible to integrate staffing and scheduling with quality systems?

Question 21.5: Top concerns of nurse executives today are what factors?

a. Adequate staffing and scheduling solutions only
b. Keeping costs of nursing low
c. The top concerns for nursing executives today, are patient satisfaction/patient experience, quality of care, patient safety, and controlling costs
d. The top concerns for nursing executives today are finding qualified nurses in IT

Question 21.6: True or False? When hospitals have accurate staffing, nurse burnout and dissatisfaction can drop significantly.

Question 21.7: What are three IT techniques to communicate data across the continuum?

a. Standards such as ICD, Nursing Diagnosis Standards, and Standard terminology
b. Health Level 7 (HL7) Messaging, Service Oriented Architecture (SOA), and Publish-Subscribe Architecture (Pub-Sub)
c. Purchasing the same EHR, Staffing system, and Scheduling system across the continuum
d. There is no way to use IT techniques to communicate data across the continuum

Question 21.8: What is driving the ability to effectively match nurse staffing to patient outcomes?

- **a.** The opportunity to retrospectively evaluate staffing through analysis of the large data sets that the process of staffing generates to improve quality and financial outcomes
- **b.** Predictive analysis alone drives staffing to outcomes
- **c.** Including all components of standards in the EHR
- **d.** None of the above

Question 21.9: The goal of developing predictive analytics models is to _______________?

- **a.** Predict patient census, acuity and matching that data with the availability and competency of the nursing/caregiver staff is enormous
- **b.** Predict the costs of nursing staffing for the following year's budget
- **c.** Predict the patient dissatisfactions that will arise over the next fiscal year
- **d.** (b) and (c) only

Question 21.10: The challenge for the future of staffing and scheduling systems is?

- **a.** Getting nurse executive to buy the systems
- **b.** Getting nurse managers to use the systems
- **c.** The challenge today is that we are finding that while we have the critical employee data, it is stored across many disparate databases that are not integrated with each other
- **d.** The challenge today is that we are finding that while we do not have the critical employee data

ANSWERS AND EXPLANATIONS

Question 21.1: (b) A Workload Management System.

Question 21.2: (a) A Workload Management system might include: Licensure information, Certification skills information such as PALS, ACLS, Current contact information, Employee work preferences, Competency to "float" or work on a variety of units, Assess and match the competencies of the nurse, Use perspective and predictive analytics for effective staffing, and Integrate quality metrics with staff outcomes.

Question 21.3: (c) Effective staffing and scheduling depends upon information from a variety of sources such as projected admissions, acuity of patients, and expected length of stay.

Question 21.4: False. It is now possible to integrate quality data with the staffing process.

Question 21.5: (c) The top concerns for nursing executives today, are patient satisfaction/patient experience, quality of care, patient safety, and controlling costs.

Question 21.6: True. According to the Agency for Health Research and Quality (AHRQ), the risk of nurse burnout increases by 23 percent and dissatisfaction by 15 percent for each additional patient a nurse receives. (Furillo, 2014) However, when hospitals have accurate staffing, nurse burnout and dissatisfaction can drop significantly.

Question 21.7: (b) To communicate data across the continuum Health Level 7 (HL7) Messaging, Service Oriented Architecture (SOA), and Publish-Subscribe Architecture (Pub-Sub) are IT techniques.

Question 21.8: (a) The opportunity to retrospectively evaluate staffing through analysis of the large data sets that the process of staffing generates to improve quality and financial outcomes.

Question 21.9: (a) The goal of developing predictive models to more accurately predict patient census, acuity and matching that data with the availability and competency of the nursing/caregiver staff is enormous.

Question 21.10: (c) The challenge today is that we are finding that while we have the critical employee data, it is stored across many disparate databases that are not integrated with each other.

22

Informatics and the Healthcare Industry

• OBJECTIVES

1. Define concepts of eHealth, telehealth, and mHealth.
2. Explore applications of eHealth for healthcare, education, and research.
3. Examine evidence on the impact of eHealth in health promotion and health maintenance.
4. Analyze the transformational nature of eHealth within the healthcare industry.
5. Discuss a telehealth case study.

• KEY WORDS

Telemedicine
Telehealth
eHealth
mHealth
Personal health records
Electronic data exchange
Healthcare reform

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Do you use any mobile health applications? Does your doctor interact with any patients at a distance using technology? Can you give examples of telemedicine technology? Do you use a personal health record, PHR? Why would the use of a PHR be important? How do you think the use of mobile technology impacts healthcare delivery today and in the future?

For a WIIFM statement, say to the class, "This chapter highlights the transformations in healthcare and education within the context of advances in computing and communications technologies. The goals of this chapter are twofold: to explore how eHealth innovations will transform healthcare, education, and research and to present the challenges and issues as a result of these potential transformations. The chapter covers the progression of eHealth applications; eHealth and other associated concepts; future innovations in advanced practice, education, and research; and the challenges and issues arising as a consequence of these transformations." As a nurse, it is important to understand eHealth innovations and the influence on healthcare today and in the future.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

Teaching Tip

Provide this information if not provided as WIIFM, This chapter highlights the transformations in healthcare and education within the context of advances in computing and communications technologies. The goals of this chapter are twofold: to explore how eHealth innovations will transform healthcare, education, and research and to present the challenges and issues as a result of these potential transformations. The chapter covers the progression of eHealth applications; eHealth and other associated concepts; future innovations in advanced practice, education, and research; and the challenges and issues arising as a consequence of these transformations.

Historical Context of eHealth

1. Telemedicine
    - **a.** The rudimentary roots of telemedicine extend back to ancient times
        - **(1)** Where simple forms of distance communication, such as the use of light reflections and smoke signals
        - **(2)** Were used to relay messages about external threats, famines, and disease
    - **b.** Long-distance communication evolved from
        - **(1)** These modest beginnings to systems such as the telegraph and the radio
        - **(2)** And onward to advanced digital communication and communication systems
2. Telehealth
    - **a.** Telehealth applications have evolved from
        - **(1)** Simple communications
        - **(2)** To sophisticated, pervasive, and widespread systems in the home that make use of wireless, wearable, robotic, and multi-sensorial technologies
    - **b.** In the past, trends in telehealth applications were grouped according to the various media
        - **(1)** Voice
        - **(2)** Data
        - **(3)** And video
    - **c.** With the convergence of these technologies, newer technologies merge across these media
    - **d.** Despite these newer technologies, voice applications remain a mainstay of telehealth applications
    - **e.** The tools of telemedicine
        - **(1)** Offer effective and efficient solutions for remote monitoring of the chronically ill
        - **(2)** As well as an avenue to allow for diagnosis and treatment of individuals who have no access to healthcare because of geographic limitations

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Concept of eHealth

1. eHealth
    - **a.** eHealth is an emerging field of medical informatics
        - **(1)** Referring to the organization and delivery of health services and information using the Web and related technologies
    - **b.** In a broader sense, the term characterizes
        - **(1)** Not only technical development
        - **(2)** But also a new way of working, an attitude
        - **(3)** And a commitment for networked, global thinking
        - **(4)** To improve healthcare locally, regionally, and worldwide by using information and communication technology
    - **c.** eHealth represents optimism
        - **(1)** Allowing patients and professionals to do what was previously impossible
    - **d.** eHealth technologies
        - **(1)** Provide opportunities for customized and meaningful communication
        - **(2)** Enabling patients to receive individually tailored information that can be viewed and responded to at their convenience
    - **e.** Patients can also post their comments and advice to virtual communities
    - **f.** The World Health Organization identified that
        - **(1)** Technological advances
        - **(2)** Economic investment
        - **(3)** Social and cultural changes
        - **(4)** Are also contributing to the realization that the health sector must now integrate technology into its way of doing business
    - **g.** eHealth
        - **(1)** Can empower consumers and patients
        - **(2)** And it opens doors for new types of relationships, such as shared decision making between a patient and his healthcare provider
    - **h.** eHealth is the single-most important revolution in healthcare since the advent of modern medicine, vaccines, or even public health measures like sanitation and clean water
2. The concept of telehealth
    - **a.** The American Telemedicine Association (ATA) uses the terms *telemedicine* and *telehealth* interchangeably
    - **b.** “Telemedicine is the use of information exchanged from one site to another via electronic communications to improve patients’ health status
    - **c.** Closely associated with telemedicine is the term *telehealth*, which is often used to encompass a broader definition of remote healthcare that does not always involve clinical services”
    - **d.** Telehealth can be considered another component of the eHealth concept, with the difference being around the delivery mechanisms, which can include
        - **(1)** Live video conferencing
        - **(2)** Store-and-forward systems, such as those used to store digital images

    - **(3)** Telephone conferencing
    - **(4)** Remote patient monitoring
    - **(5)** e-Visits via a secure Web Portal
  - **e.** Teleconferencing and digital networking systems are now merging, giving rise to "group consultation" opportunities
  - **f.** While variations in the definitions of telemedicine and telehealth exist
  - **g.** There is agreement on the broad conception of this field as, "the delivery of personal and non-personal health services and of consumer and provider education as well as a means for safeguarding the living environment via information and communication technology"
  - **h.** Using the broadest definition of telehealth as a foundation, this chapter will
    - **(1)** Explore the past, present, and future innovations
    - **(2)** As they apply to healthcare delivery, education, and research

- **3.** The concept of mHealth
  - **a.** Another component of eHealth is mobile-health (mHealth), which can be considered a delivery mechanism for eHealth
  - **b.** mHealth typically refers to the use of a wireless communication device that supports public health and clinical practices
    - **(1)** mHealth is seen as a valuable tool as the digitization of health and wellness data increases
    - **(2)** It is postulated that many tools will be required, as no single tool will serve all needs for all people
    - **(3)** As a result, there is a need to stop focusing on the technological components separately and work toward aggregating these communication technologies in an integrated system
    - **(4)** Once this is accomplished, an ecosystem for integrated broad-scale deployment of eHealth tools can be achieved
  - **c.** mHealth is viewed as the new generation of telemedicine that is laying the foundation for a new generation of healthcare
    - **(1)** eHealth has a focus on using electronic medical records and other technologies, while mHealth focuses on behavioral and structural changes
    - **(2)** The current idea that telemedicine requires dedicated connections does not fit the new world view of mHealth
    - **(3)** The mHealth revolution is introducing patient-centered, communication-based care in a system that includes wellness and healthcare providers
  - **d.** The healthcare model itself is
    - **(1)** Moving from a provider-driven one
    - **(2)** To a largely participatory model
    - **(3)** Including all stakeholders such as long-term caregivers, dentists, insurance companies, hospitals, public health officials, primary care providers, consumers, and health systems involved in wellness
  - **e.** It is crucial to note that these changes will be global in distribution
    - **(1)** mHealth is going to allow basic care to be provided that might not otherwise be available in regions of African, Asia, and South America
    - **(2)** In developing countries, mobile phones far outnumber personal computers, and they offer support services on both health and technology fronts
    - **(3)** The power of these technologies to improve health and the human condition cannot be underestimated: "Modern telecommunications, and the creative use of it, has the power to change lives and help … solve some of the world's biggest challenges"
    - **(4)** For most of the world this will be the only computer they will own; it is on the Web and they can carry it everywhere
    - **(5)** The impact on healthcare could be great
  - **f.** As mHealth continues to progress, nursing care will need to evolve
    - **(1)** Traditionally, nurses have been hands-on caregivers
    - **(2)** Now, nurses are challenged with developing new models for nursing care that address "care at a distance" using innovations such as mobile phones and text messaging
    - **(3)** Communication is at the core of nursing care
    - **(4)** The methods of communication are rapidly changing and growing
    - **(5)** Nurses will be able to utilize text messaging over a secure network to send automated appointment reminders, health tips, and messages about available resources in the area
    - **(6)** Nurses will need to consider their standards of care and the impact these new modalities will have on care delivery

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

eHealth Applications

- **1.** Overview
  - **a.** Telehealth has both clinical and nonclinical uses
  - **b.** Nonclinical applications include
    - **(1)** Professional education
    - **(2)** Healthcare administrative duties
    - **(3)** Research
    - **(4)** And the aggregation of health data, excluding patient-specific medical treatments and decisions
  - **c.** Clinical uses include
    - **(1)** Medical decisions involving patient care
    - **(2)** Diagnostics
    - **(3)** And treatments
  - **d.** These two categories are somewhat blurred
    - **(1)** As patients and providers exchange e-mail communications that are being stored in the patient's computerized record
  - **e.** Clinical applications for telemedicine can be provided
    - **(1)** At the point of service
    - **(2)** Or at another location (e.g., in the home for patients who may be homebound, who reside in rural communities, or who are living in correctional facilities)

- **f.** Telehealth applications can be specialized, such as with
  - **(1)** Telepathology
  - **(2)** Telepsychology
  - **(3)** Or remote patient monitoring services for ICUs in acute care facilities
- **g.** Telehealth is forging new relationships between patients and all types of practitioners
- **h.** It is moving care out the physician-centric perspective into the 21st century model of healthcare that will see more consumer empowerment

2. Impact of the Web

- **a.** Today, 85 percent of American adults (ages 18 and older) are using the Web
  - **(1)** Seventy percent of them access via broadband connections at home
  - **(2)** And 61 percent connect wirelessly to the Web via their laptops or 56 percent with smartphones
- **b.** A 2010 Pew Internet and American Life Project study indicates
  - **(1)** Eighty-nine percent of adults with no chronic diseases go online
  - **(2)** While only 72 percent of adults living with chronic disease are likely to access the Web
- **c.** These findings are in line with trends in public health and technology adoption
- **d.** Chronic disease is typically associated with
  - **(1)** Being older
  - **(2)** African American
  - **(3)** Less educated
  - **(4)** And living in a lower-income household
- **e.** While Internet use is associated with
  - **(1)** Being younger
  - **(2)** White
  - **(3)** College educated
  - **(4)** And living in a higher-income household
- **f.** People living with chronic disease
  - **(1)** Have complicated health issues
  - **(2)** And are disproportionately offline
- **g.** Those who are online
  - **(1)** Have additional support
  - **(2)** They have each other
- **h.** Two online activities that are common among people living with chronic diseases are
  - **(1)** Blogging
  - **(2)** And online health discussions
- **i.** Having a chronic disease significantly increases the likelihood that the user will use the Web to read and share information
- **j.** “Nuggets” of information are discovered via these online discussion groups; individuals in the groups connect and they “just keep going”

3. Consumer engagement

- **a.** The National eHealth Collaborative developed the Patient Engagement Framework to
  - **(1)** Assist healthcare organizations in developing a strategic plan
  - **(2)** To incorporate eHealth tools and resources as part of an overall engagement strategy
- **b.** The framework includes five phases

Teaching Tip
See Table 22.1

4. Personal health records

- **a.** Personal health records (PHR) are
  - **(1)** Maintained by the patient
  - **(2)** In contrast to the medical record that is maintained by providers at the various clinical agencies caring for the patient
- **b.** The PHR facilitates patient access to information about his/her health and healthcare experiences
- **c.** Use of a PHR encourages patients to track care encounters and collect relevant health information to share in care management
- **d.** Google Health is a Web-based PHR
  - **(1)** Users can build health profiles
  - **(2)** Import records from hospitals and pharmacies
  - **(3)** Share their records
  - **(4)** And explore online health services

5. Managing health conditions and accessing resources

- **a.** Electronic resources are being used increasingly to learn about and manage health conditions
- **b.** Health seeking behaviors of adults with chronic conditions are notably different from those of adults in general
- **c.** Specifically, “when controlling for age, income, education, ethnicity, and overall health status”, internet users living with one or more conditions are *more likely* than other online adults to
  - **(1)** Gather information online about medical problems, treatments, and drugs
  - **(2)** Consult online reviews about drugs and other treatments
  - **(3)** Read or watch something online about someone else’s personal health experience
- **d.** Those with chronic conditions are more likely to
  - **(1)** Fact check information found on the internet with their clinicians
  - **(2)** As well as track personal data related to health and wellness

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Transforming the Practice of Healthcare

1. Wearable and portable monitoring systems
    - **a.** Remote patient monitoring, considered experimental a few years ago, is now maturing, with a number of applications available
    - **b.** The VitalJacket is one example that utilizes microelectronics in a wearable T-shirt that continuously monitors electrocardiogram waves and heart rate
        - **(1)** The shirt can be used for patients or for healthy subjects involved in fitness activities or sports
    - **c.** A system available today from BodyMedia is a wearable monitoring system that focuses on weight loss, health, and fitness
        - **(1)** The armband has sensors that collect heat flux, galvanic skin response, skin temperature, as well as an accelerometer
        - **(2)** Utilizing a USB cable, one can sync the data with Activity Management software where it is stored and can be tracked by the user
    - **d.** The Health Buddy System is a remote monitoring platform that provides a daily interface between care coordinators and patients with chronic illnesses
        - **(1)** This system has a proven track record over the past decade
        - **(2)** The appliance can also connect glucose meters, weight scales, blood pressure cuffs, and other medical devices so additional patient data are sent to the healthcare professionals
        - **(3)** Health Buddy has been used with a variety of patients, including coronary artery bypass graft, chronic heart failure, diabetes, and asthma
        - **(4)** Care providers' access data that can provide an early alert of warning signs that the patient is deteriorating
        - **(5)** It addresses gaps in care before the patient becomes critical
2. Telenursing and decision support tools
    - **a.** Telenursing is broadening the role of nurses and advancing their value in the chain of healthcare delivery to consumers in remote regions or to homebound patients
    - **b.** Home health nursing via visual communication is a technique that provides accessible care and reduces both travel time and expense
        - **(1)** Using videophones, the nurse and the patient can establish a more personal relationship
        - **(2)** Images can be transmitted interactively from the patient's home directly to attending physicians improving follow up and treatment for things such as leg wounds
        - **(3)** This technology can be used to plan care interventions and to train patients and their caregivers
        - **(4)** Utilizing field notes, photos, and video-recorded dialogues, all care providers can easily follow any changes in leg wounds
    - **c.** Teletriage is a component of telenursing
        - **(1)** Decision support tools have been developed as a guide for the teletriage nurse assessing a patient
        - **(2)** These tools provide the nurse with structure around the teletriage processes
        - **(3)** Utilizing these decision support tools, along with nursing judgment and critical thinking skills, helps to minimize risk when providing telephone assistance

Teaching Tip

Provide the example, for example, the Medicare Quality Improvement Community (MedQIC) Web site has a free online teletriage resource toolkit to support consistent and appropriate teletriage assessments for many conditions including adverse drug reaction; breathing difficulty; depression; feeding tube problems; nausea, vomiting, and fluid loss; wound drainage; and pain management.

3. Possibility of virtual worlds
    - **a.** Web-based 3D virtual worlds are currently being investigated as a potential tool to engage a variety of audiences in
        - **(1)** Healthy behavior
        - **(2)** And lifestyle choices regardless of location
    - **b.** These tools are also being used as a new educational method for the healthcare professions that will help facilitate learning through interactive, collaborative learning environments
    - **c.** The 3D worlds are created online using a virtual persona, or avatar, which interacts with other avatars in the online world
        - **(1)** The Centers for Disease Control and Prevention (CDC) has established a Second Life island where users can see streaming videos and access links to information on CDC.gov
        - **(2)** The island has a virtual lab and conference center
4. Health portals and Web 2.0
    - **a.** Web 2.0 social networking sites such as Facebook, Twitter, YouTube, and MySpace are proliferating
        - **(1)** Health consumers feel empowered and now want to participate in decisions about their healthcare
        - **(2)** Support groups are using the Web as a new platform to organize, share experiences, seek online counseling, and simply connect with others
        - **(3)** Web sites are now being utilized by healthcare providers as a place to engage with colleagues on clinical and nonclinical issue
    - **b.** Hospital portals are being developed where patients can make appointments, renew prescriptions, and review test results and their medical records online
        - **(1)** An example is My Health*e*vet, which offers veterans, active duty service members, their dependents, and caregivers access anytime to VA healthcare information and services that include tracking tools and journals to help the user track their health activities
    - **c.** WebMD is a consumer portal that is a leader in providing online health information
        - **(1)** It provides the ability to browse condition-specific and wellness-related topics
        - **(2)** Individuals have the ability to participate in moderated exchanges where they can get expert feedback on

a variety of topics such as osteoporosis, skin problems, and gynecology problems

  - **(3)** There are also member-created exchanges where users discuss parenting issues or participate in a diet club

- **d.** PatientsLikeMe is a popular social networking site
  - **(1)** This site contains communities that have been developed to allow patients to become proactive
  - **(2)** The community forums include patients, doctors, and organizations
  - **(3)** Users learn about treatments and symptoms, and can participate in the forum or have one-on-one discussions
  - **(4)** The site was developed for individuals with life-changing diseases such as Amyotrophic Lateral Sclerosis (ALS), Parkinson disease, and epilepsy

5. mHealth applications
- **a.** The rapid and pervasive worldwide adoption of mobile cell phones is going to drive tremendous growth in handheld healthcare over the next decade
  - **(1)** Wireless communication technologies are forcing a transformation in how and where healthcare is delivered
  - **(2)** The abilities to collaborate, share high-resolution images, and even have live broadcasting of surgeries are all enabled by new technologies
- **b.** Applications areas for mHealth include
  - **(1)** Consumer education
  - **(2)** Emergency response systems
  - **(3)** Professional and patient communications (e.g., text messaging, e-mail, social networking)
  - **(4)** Health promotion and community mobilization
  - **(5)** And public and population health
- **c.** mHealth growth has been around the world with significant demand from “bottom-of-the-pyramid” consumers located in rural areas
  - **(1)** Pilot projects are ongoing in countries such as Indonesia, Brazil, Sudan, and Uganda. In Africa, health personnel use mobile phones to provide emergency medical care; their phones use solar charges
  - **(2)** A toll-free mobile service is being launched in remote areas of Tanzania, Kenya, and Uganda
  - **(3)** In developing economies, mHealth will be a major part of eHealth. mHealth will need to be integrated into the training of healthcare workers, so professionals have the knowledge and skills required to use the technology safely and effectively

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Impact of eHealth Applications

1. Transforming the way we learn
- **a.** Web-based educational programs are changing the way consumers and healthcare providers learn
  - **(1)** These programs continue to proliferate, providing the opportunity for interactive learning and simulations with the ability to have multiuser discussions and presentations in a collaborative learning environment
  - **(2)** Faced with limited funds, nursing schools now have the ability to form partnerships and share their resources via the virtual classroom
  - **(3)** The Web allows nurses and students the ability to access the most up-to-date research and knowledge facilitating evidence-based practice
  - **(4)** Technological innovations, such as video streaming and virtual reality 3D displays, are providing more sophisticated formats in which to deliver educational materials
  - **(5)** Web-based educational programs can reach remote students who otherwise would be unable to attend class
- **b.** The role of the nurse as a patient and consumer educator in the digital age is evolving as well
  - **(1)** Online educational materials can be tailored to an individual’s literacy level and presented in a bilingual format
  - **(2)** The advent of Massively Open Online Courses (popularly known as MOOCs) provides accessible and free learning across the globe
  - **(3)** Major universities are considering offering credit for these courses
  - **(4)** Remote interactive telehealth networks have been shown to be effective in providing preoperative patient education to rural locations and are increasingly being used for disease management

2. Transforming healthcare delivery
- **a.** Electronic data exchange
  - **(1)** Advances in eHealth and the growing use of electronic health records have contributed to the realities of health data exchange
  - **(2)** During the 1990s, hospitals attempted to create community health information networks to share information at the community level
  - **(3)** Concerns for patient privacy, the high costs of system implementation, and access to information by competing organizations prevented widespread use and acceptance of this innovation
  - **(4)** In the United States, the federal government took a leadership role in health information exchange when the National Committee for Vital and Health Statistics published a report titled “A Strategy For Building a National Health Information Infrastructure” in 2001
    - **i.** This report indicated that “such a capability would improve response in individual and public health emergencies, reduce unnecessary care, decrease the likelihood of adverse events, improve patients’ self-management capabilities, and generally enable improve management of chronic disease”
    - **ii.** Further federal leadership occurred in 2004, when President George Bush created the Office of the National Coordinator for Health Information Technology to connect clinicians and improve population health
    - **iii.** Funding for the effort became available through the Health Information Technology for Economic and Clinical Health (HITECH) Act, part of the American Recovery and Reinvestment Act of

2009, which provided over $19 billion with incentives for electronic health record implementation further supporting the possibility of electronic health information exchange

b. Payment reform through meaningful use

(1) The HITECH Act also introduced the concept of "meaningful use"

i. The idea was that not only should providers use electronic records within their practices, they should make use of the information available to enhance patient care outcomes

ii. "Per statute, a provider must demonstrate meaningful use by (1) use of certified EHR technology in a meaningful manner such as e-prescribing; (2) that the certified EHR technology is connected in a manner that provides for the electronic exchange of health information to improve the quality of care; and (3) in using this technology, the provider submits to the secretary information on clinical quality measures and such other measures selected by the secretary"

(2) The funding makes $27 billion available in incentives for eligible providers (maximum $44,000 per provider) who participate in Medicaid and Medicare programs during the five-year, phased implementation period beginning in 2011

(3) Providers who fail to attest to meaningful use will be assessed penalties beginning in 2015

(4) Attestation requires providers to meet 15 core measure requirements such as recording vital signs, using electronic prescribing, and maintaining an electronic problem list

(5) An initial evaluation of the program indicates that providers are successfully meeting requirements and even exceeding thresholds established by the Centers for Medicare and Medicaid Services

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Research Opportunities

1. Overview

a. Much is written on how eHealth applications may help provide care for an aging population, improve care in rural areas, and decrease healthcare disparities in the United States and increasingly around the world

(1) There is an increasingly important need to look at the impact of eHealth applications on the care provider–patient relationship and how these applications affect outcomes

b. There is a need to study symptom management and effectiveness of "distant" clinical assessments to identify standardized best practices

(1) The effectiveness of electronic communication methods as avenues to provide healthcare will need to be researched

(2) Nursing research will need to adapt to this ever-evolving landscape of technologies

c. Unique methodological research issues and challenges for nursing around the use of information and communication technologies (ICT) have been identified

(1) The focus of research efforts needs to be on "understanding what intervention component, through what mechanism, for whom, and under what conditions will produce the most optimal health outcome"

(2) Specification of the research focus will facilitate more refinement of individual ICT components that appear to be effective

(3) Researchers have found three factors in consumer health applications that had a significant effect on health outcomes: (1) individual tailoring, (2) personalization, and (3) behavioral feedback

(4) While randomized controlled trials provide evidence for the effectiveness of an intervention relative to a control, there is difficulty in finding consistency of control groups when studying ICT applications

(5) With the increasing pervasiveness of eHealth, nurse researchers will have to evolve their scientific approaches in order to produce the practice-based evidence that is going to be needed

d. Another gap in current research is on the use of telehealth applications for emergency and disaster preparedness and response

(1) There are opportunities for interdisciplinary research on public health surveillance networks to determine pattern recognition algorithms that address threats to public health, including flu outbreaks, environmental disasters and man-made threats such as terrorist attacks

2. Transforming emergency preparedness and response

a. During a disaster situation, the use of telehealth technology would allow clinicians to provide healthcare services remotely

(1) A locally based network of clinicians linked via modern communication would help reduce major disruptions in healthcare

(2) Protocols need to be developed for mobile communication devices before disasters so they can be rapidly deployed to provide routine care, triage, and shelter-in-place medical care

b. Advanced wireless electronic technologies are the quickest vehicles to communicate needs during emergency situations

(1) State, federal, and international emergency efforts have not evolved as rapidly as these new technologies

(2) However, some communities are turning to subscription services to notify residents of threats related to severe weather

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

eHealth Challenges and Issues

1. Overview
   - **a.** Innovations in eHealth do not come without challenges and issues that healthcare professions must address
   - **b.** As the transformation of healthcare moves toward patient-centric models, the healthcare professionals must resolve some key challenges and issues
   - **c.** These issues concern on legal, ethical, and public policy arenas
2. Licensure
   - **a.** The lack of infrastructure for interstate licensure was a key impediment to the growth of telehealth
     - **(1)** The U.S. Congress contracted with the Center for Telemedicine Law for a background paper concerning telehealth licensure issues in early 1997
     - **(2)** Alternative approaches to licensure outlined in that report include consulting exceptions, endorsement, mutual recognition, reciprocity, registration, limited licensure, national licensure, and federal licensure
     - **(3)** Additionally, in 2010, the Centers for Medicare and Medicaid Services (CMS) proposed a rule that would allow a streamlined credentialing and privileging process for physicians and practitioners providing telemedicine services
3. Ethical issues
   - **a.** The predominant ethical issues concerning telehealth are privacy, confidentiality, and security
   - **b.** The following definitions have been set forth by the American Society for Testing and Materials Committee E31 on Healthcare Informatics, Subcommittee E31.17 on Privacy, Confidentiality, and Access
     - **(1)** *Privacy*
       - **i.** "The right of individuals to be left alone and to be protected against physical or psychological invasion or the misuse of their property
       - **ii.** It includes freedom from intrusion or observation into one's private affairs, the right to maintain control over certain personal information, and the freedom to act without outside interference"
     - **(2)** *Confidentiality*
       - **i.** The "status accorded to data or information indicating that it is sensitive for some reason, and therefore it needs to be protected against theft, disclosure, or improper use, or both, and must be disseminated only to authorized individuals or organizations with a need to know"
     - **(3)** *Data security*
       - **i.** "The result of effective data protection measures; the sum of measures that safeguard data and computer programs from undesired occurrences and exposure to accidental or intentional access or disclosure to unauthorized persons, or a combination thereof; accidental or malicious alteration; unauthorized copying; or loss by theft or destruction by hardware failures, software deficiencies; operating mistakes; physical damage by fire, water, smoke, excessive temperature, electrical failure or sabotage; or a combination thereof"
     - **(4)** *System security*
       - **i.** "Security enables the entity or system to protect the confidential information it stores from unauthorized access, disclosure, or misuse, thereby protecting the privacy of the individuals who are the subjects of the stored information"
   - **c.** It is imperative that providers and healthcare systems establish policies concerning privacy, confidentiality, and security as they create systems to facilitate patient-centered care through the provision of eHealth

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Emerging Issues and Challenges

1. Overview
   - **a.** For all the possibilities it presents, eHealth does come with challenges, including privacy concerns, equity across populations, and the need to define a new type of relationship between the patient and healthcare provider
     - **(1)** Other issues include integration and networking interoperability, and usability
     - **(2)** There is the challenge to determine what impact these new technologies will ultimately have on patient outcomes
   - **b.** Disparities in healthcare and access to care still persist and a true solution eludes us
     - **(1)** Underserved communities can benefit from improved access to clinical expertise in specialties such as oncology, radiology, infectious disease, and psychiatry
     - **(2)** Further, reimbursement for telehealth interventions and a positive cost-benefit ratio are necessary before providers can consider adopting technological innovation into their practice environments
     - **(3)** Health systems may want to fund programs if telemedicine visits prevent trips to congested emergency departments
     - **(4)** As the healthcare industry is forced to deliver more with less, flexible telemedicine will need to come to the mainstream
2. Regulation of mHealth applications
   - **a.** A recent development regarding mHealth is rules by the United States Food and Drug Administration to regulate a small segment of these applications
     - **(1)** The FDA is interested in regulating mobile medical applications that meet the definition of a medical device, are intended to be used as an accessory to a regulated medical or transform a mobile platform into a regulated medical device

    (2) Specifically
        i. Mobile applications that are an extension of one or more medical device(s) or displaying, storing, analyzing, or transmitting patient-specific medical device data
        ii. Mobile applications that transform the mobile platform into a medical device by using attachments, display screens, or sensors or by including functionalities similar to those of currently regulated medical devices
        iii. Mobile applications that allow the user to input patient-specific information and through the use of formulae or processing algorithms, output a patient-specific result, diagnosis, or treatment recommendation to be used in clinical practice or to assist in making clinical decisions

3. Public policy
    a. The American Telemedicine Association outlined guidelines to "advance the science, to assure uniform quality of service to patients, and to promote reasonable and informed patient and provider expectations"
    b. These guidelines include administrative, clinical, and technical recommendations designed to provide a safe, quality, telehealth experience

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- Without a doubt, eHealth applications will proliferate in the future
- Healthcare professionals need to seize the opportunities made possible by advanced technologies and create powerful and human-centered applications to facilitate consumers' full participation in health and wellness
- To evolve this process, healthcare professional need to be actively involved in resolving challenges, shaping public policy, and evaluating health outcomes

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Define concepts of eHealth, telehealth, and mHealth
- Explore applications of eHealth for healthcare, education, and research
- Examine evidence on the impact of eHealth in health promotion and health maintenance
- Analyze the transformational nature of eHealth within the healthcare industry
- Discuss a telehealth case study

Teaching Tip
Ask the students to define the keywords

- Telemedicine
- Telehealth
- eHealth
- mHealth
- Personal health records
- Electronic data exchange
- Healthcare reform

CHAPTER REVIEW QUESTIONS

Question 22.1: e-Health is defined as ______________?

a. eHealth is an emerging field of medical informatics, referring to the organization and delivery of health services and information using the Web and related technologies
b. eHealth is the field of informatics using a handheld device
c. eHealth is the use of data, voice or video for communications
d. eHealth cannot be defined since it is an evolving method

Question 22.2: Telehealth is defined as ________________?

a. Telehealth is the use of wire, radio, optical or other electromagnetic channels to transmit and receive signals for voice, data, and video communications
b. Telehealth is the emerging field in medical informatics, referring to the organization and delivery of health services and information using the Web and related technologies
c. Telehealth is the field of informatics using a handheld device
d. Telehealth cannot be defined since it is an evolving method

Question 22.3: mHealth refers to ____________________?

a. mHealth refers to the use of a wireless communication device that supports public health and clinical practices
b. mHealth is the use of wire, radio, optical or other electromagnetic channels to transmit and receive signals for voice, data, and video communications
c. mHealth is an emerging field of medical informatics, referring to the organization and delivery of health services and information using the Web and related technologies
d. mHealth cannot be defined since it is an evolving method

Question 22.4: Which is the most used component of eHealth?

a. Telehealth
b. mHealth
c. Digital gaming
d. None of the above

Question 22.5: The primary ethical issues of telehealth are:

a. The predominant ethical issues concerning telehealth are privacy, confidentiality, and security
b. Security only

c. Privacy only
d. Confidentiality only

Question 22.6: True or False? Disparities in healthcare and access to care still persist and a true solution eludes us.

Question 22.7: The most expensive form of eHealth is?

a. mHealth because you have to buy all the equipment and contracts
b. Telehealth is still the most expensive form of eHealth
c. There is no difference is any of the eHealth applications
d. All of the costs are subsidized by CMS

Question 22.8: What professional organization develops policies related to telehealth?

a. AMIA
b. HIMSS
c. ANIA
d. The American Telemedicine Association

Question 22.9: Issues in broad scale use of telehealth include what factors?

a. Reimbursement, credentialing of clinicians using telehealth
b. Malpractice litigations when the care is in one state and the healthcare provider is in another state
c. Compact state licensures
d. All of the above

Question 22.10: What should the focus be when conducting research on eHealth?

a. Security and privacy
b. Patient outcomes
c. Focus on "understanding what intervention component, through what mechanism, for whom, and under what conditions will produce the most optimal health outcome"
d. Focus on the effectiveness of care

ANSWERS AND EXPLANATIONS

Question 22.1: (a) eHealth is an emerging field of medical informatics, referring to the organization and delivery of health services and information using the Web and related technologies.

Question 22.2: (a) According to the Institute of Medicine (IOM, 1996), "it is the use of wire, radio, optical or other electromagnetic channels to transmit and receive signals for voice, data, and video communications."

Question 22.3: (a) mHealth refers to the use of a wireless communication device that supports public health and clinical practices.

Question 22.4: (b) mHealth

Question 22.5: (a) The predominant ethical issues concerning telehealth are privacy, confidentiality, and security.

Question 22.6: True. Disparities in healthcare and access to care still persist and a true solution eludes us.

Question 22.7: (b) Telehealth is an equipment-intensive program, and it is expensive to get started.

Question 22.8: (d) The American Telemedicine Association (2010a) outlined policy initiatives concerning rulemaking within the Centers for Medicaid and Medicare services to facilitate reimbursement for telemedicine care.

Question 22.9: (d) All of the above. There are many issues in broad scale use of telehealth, including Medical Staff Credentialing and Privileging for Telehealth Networks, Expand Medicare coverage for telehealth, Remove Medicare barriers, Encourage remote monitoring, home telehealth, and chronic disease care, Expand Medicaid coverage for telehealth, National broadband deployment and upgrade, Streamline and expand the rural health program, Encourage Interconnections of Remote Healthcare Networks, Expand support for universal services, Support Federal Programs and Initiatives that Deploy Telemedicine Technology and Services, Resolve Barriers to Telemedicine, State Physician Licensure, Interstate Compacts, Internet Practice Issues (most notably concerning e-mail consultations, prescribing medications, and facilitating meeting consumer demand), Malpractice Coverage, and Use Telemedicine for Emergency Preparedness and Response.

Question 22.10: (c) Nugyen (2010) identifies unique methodological research issues and challenges for nursing around the use of information and communication technologies (ICT). Research efforts should not focus on the effectiveness of healthcare delivered through different modes; rather, the focus needs to be on "understanding what intervention component, through what mechanism, for whom, and under what conditions will produce the most optimal health outcome" (p. 31).

PART 5

Advanced Nursing Informatics in Practice

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23

Structuring Advanced Practice Knowledge: An Internet Resource for Education and Practice

• OBJECTIVES

1. Articulate support for the advanced nursing, healthcare technologic, and organizational science domains of advanced practice.
2. Create structures that reflect the integration of doctor of nursing practice knowledge/competencies between and within domains.
3. Select reliable and appropriate Web-based content within advanced practice knowledge/competency domain categories.

• KEY WORDS

Advanced practice
Nursing
Reflection
Structures
Domain(s)
Categories
Healthcare
Technology
Informatics
Organization
Knowledge
Competencies
Curriculum
Education
Database
Pain
Management

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Is it important to structure information? Why is information important in the delivery of healthcare? Why would it be important to structure health information? How do you evaluate health information that you find on the Internet? Why is it important to evaluate health information retrieved from the Internet? Can you explain, describe, or define advanced practice nurse?

For a WIIFM statement, say to the class, "While informatics may begin with reflection, it does not end with reflection. One product of reflection is the structuring of Information. Reflection on the structure of advanced practice nursing education and practice at the doctoral level led ultimately to a three-dimensional model presented in this chapter. It is a model that combines knowledge and competencies within three domains. It also serves as a framework for creating a Web-based information databases to assist either the academician or practitioner." As a nurse, it is important to understand the structure of the advanced practice education as well as the structuring of information.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Improving Health and Healthcare Through Nursing

1. Overview
    - **a.** Advanced practice nurses manage information
    - **b.** Information comes in many shapes and forms
    - **c.** One form revolves about initiatives aimed at improving health and healthcare through nursing
    - **d.** This movement received its greatest impetus in the 2010 IOM report, *The Future of Nursing*, with its brief on the *Focus on Scope of Practice*
        - **(1)** It calls for the States to remove inconsistent barriers to practice and the federal government to advance the reforms needed through the work of Congress and regulatory agencies
        - **(2)** The chair was Donna Shalala, President of the University of Miami and former Secretary of the Department of Health and Human Services; the vice-chair was Linda Burnes Bolton, DPH, RN, FAAN
        - **(3)** This report led to a "Campaign for Action," a joint endeavor by AARP and the Robert Wood Johnson Foundation
        - **(4)** Actions were directed toward building a stakeholder base, initiating action at local, state, and national levels, communicate the call to action, and monitor results
    - **e.** Campaign progress is available on a dashboard
    - **f.** Coalitions are active within the majority of states
    - **g.** In December 2013, AARP in Virginia announced its part in a 4.5 million dollar program
        - **(1)** Funded by the Robert Wood Johnson Foundation to help states move forward in advancing the goals of the *Future of Nursing* report to improve health and healthcare through nursing, most notably healthcare access, quality and cost
        - **(2)** Nine other states received funding at the same time
        - **(3)** These were: Alabama, Alaska, Arkansas, Illinois, Minnesota, Nevada, Ohio, South Caroline, and Vermont
    - **h.** A powerful, non-nurse voice in support of advanced practice is found in the 2014 Miller Center Report on Cracking the Code on Health Care Costs
        - **(1)** Its recommendations include eliminating within-state scope of advanced practice barriers and establishing a place at the healthcare cost table of all stakeholders, including all providers (physician and nonphysicians alike)
            - **i.** The authors of this Miller Center report were the members of State Health Cost Containment Commission
            - **ii.** There were no nurses on the Commission
            - **iii.** On the one hand, this may seem to be a contradiction on the part of a Commission recommending a place at the table for all stakeholders
            - **iv.** On the other hand, the Commission consisted of healthcare system CEOs and was chaired by two former governors, one of whom is also a former Secretary of the Department of Health and Human Services under President George W. Bush, the Honorable Michael O. Leavitt
            - **v.** In brief, the report is a strong endorsement for eliminating scope of practice barriers by a highly competent, politically influential, non-nurse healthcare commission
            - **vi.** It is a document well worth quoting in every State, where nurses are acting to eliminate the scope of practice barriers, attain voice at the table, and provide quality care while working to contain healthcare costs

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Structuring Knowledge and Its Relationship to Advanced Practice

1. Overview
    - **a.** Much of informatics involves reflection
        - **(1)** Reflection upon a single question led to the First National Conference on the Classification of Nursing Diagnoses in 1973 and the birth of NANDA
        - **(2)** The question was "How are nursing data going to be entered into the computer"
        - **(3)** Reflection helps people create advances in health information technology
        - **(4)** The number, kind, and design of self-management apps require hours of individual and group reflection
        - **(5)** Reflection helps people adapt to technology as it influences the acceptance of scientific information
        - **(6)** Reflection on professional practice deepens when benchmarks of practice are improved
        - **(7)** Reflection is central whenever change is being anticipated, created, required to improve practice, or needed to facilitate adjustment to technological changes already underway
    - **b.** While informatics may begin with reflection, it does not end with reflection
        - **(1)** One product of reflection is the structuring of Information

(2) Reflection on the structure of advanced practice nursing education and practice at the doctoral level led ultimately to a three-dimensional model presented in this chapter

(3) It is a model that combines knowledge and competencies within three domains

(4) It also serves as a framework for creating a Web-based information databases to assist either the academician or practitioner

(5) Let's begin, however, a word on the meaning of knowledge structures

c. Because some readers may operate more concretely than conceptually, it is important to provide some examples of the structuring of knowledge and its several ramifications

(1) Structuring is what we do when we

i. Categorize

ii. Recognize categories or classes

iii. Place categories within domains

iv. Or identify the domains and classes within a taxonomy and display results graphically

d. Structuring also occurs when we recognize or name clusters within an actual or mathematically imposed space

(1) We examine the relationship of one cluster to other clusters

(2) Statistically, we think of cluster analysis

(3) Astronomically, we think of the Milky Way. Epidemiologically, we think of cluster maps showing the spread of infectious disease

e. Finally, we structure knowledge when we look at its various dimensions

(1) Knowledge is not one-dimensional

(2) It may be pictured within two dimensions as in a matrix

(3) Knowledge may be distributed within dimensions

(4) It may be poly-dimensional/polygonal, like the facets of a diamond, changing slightly as light or perspective changes

(5) Knowledge may be Web-like as that built by a spider, which glides, climbs, leaps from one knowledge strand to another, all the while remaining connected to its center

f. This imaginative exercise has meaning

(1) The ability to structure knowledge facilitates learning

Teaching Tip

Provide the example, the American Nurses Credentialing Center (ANCC) structures or outlines the categories of knowledge covered by the Nurse Practitioner Certification Exams. Each of the many specialties has its own structure, its own content outline. The ANA structures nursing practice with its standards. The nursing terminologies structure nursing concepts within classifications. The purpose of this chapter is to structure the knowledge base of the doctorally prepared advanced practice nurse.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Comparisons of Advanced Practice Learning and Practice Structures

1. Overview

a. Knowledge structures evolve as our ability to articulate knowledge evolves

(1) This kind of evolution can be seen in Figs. 23.1 through 23.4

(2) Fig. 23.1 describes the progression through a DNP curriculum

(3) Fig. 23.2 describes the integration of content within a DNP capstone project

(4) Fig. 23.3 presents a newer model for assessing performance of any program, intervention bundle or intervention

(5) It is only Fig. 23.4 that presents a structure that represents knowledge undergirding both a DNP curriculum and DNP practice

Teaching Tip

We will explore Fig. 23.1 first. Some graduate curricula describe course progression linearly, first lower level foundational courses followed by higher level courses, requiring increasing integration of content (Fig. 23.1). One issue with this method of visualizing academic progression is that it assumes that integration of content occurs linearly, step-by-step. The model implies that, having climbed all steps, a graduate emerges and proceeds to practice all that has been learned. Pictorially, education has ended; practice has begun.

b. Some advanced practice courses describe the integration of content within a matrix

(1) This kind of two-dimensional structure is presented in Fig. 23.1

(2) The matrix structure allows for the tracking of knowledge integration within each DNP capstone project

(3) It is recognized that the nature of the integration will differ with each project

(4) This type of structure goes beyond the linear progression we see in Fig. 23.1

(5) Table 23.1 allows the user to see not only what courses have been completed, but how the course knowledge shapes an end-product, the DNP capstone

(6) It depicts, in computer language, input to output

Teaching Tip

Refer to Fig. 23.2. Saint Louis University School of Nursing DNP Risk Reduction Capstone Project: Matrix illustrating the opportunities for knowledge synthesis and integration within the DNP risk reduction capstone project.

c. The number of capstone projects produced is an output measure

(1) An important distinction in terminology needs to be made here

(2) We are all familiar with the terms structure, process and outcomes

  - **(3)** From the writing of Florence Nightingale we know that she was interested process outcomes (e.g., how well nurses maintained a hygienic environment)
  - **(4)** This is what we may also call *output*
  - **(5)** Nightingale evaluated patient *outcomes*, i.e., did the patient develop an infection; and, she measured *impact*, i.e., decreases in overall infection and mortality rates
  - **(6)** Both Donabedian and Nightingale would have agreed with the terms, a *culture of results* or *results based management (RBM)*, now being advocated by the United Nations Development Programme (UNDP)
  - **(7)** Fig. 23.2 presents an illustration of the UNDP program development signposts
- **d.** If these terms are to be used clinically, it helps to provide a context
  - **(1)** ***Input*** refers to structural, financial, human, or technical resources

Teaching Tip
Provide the examples which include staffing, NP educational background/experience.

  - **(2)** ***Activities*** are tasks or processes employed to produce an output, e.g., emergency department processes and treatment of patients seeking care for an infection
  - **(3)** The ***outputs*** are the end-products of the activities, whether on or off target

Teaching Tip
Provide, for example, an output is the answer to a question like: What is the proportion of multiple urgent sepsis therapies (MUST)-compliant records among ED patients, who: (1) are admitted to the ED for infection, (2) exhibit at least two signs of systemic inflammatory response syndrome, and (3) exhibit at least one sign of hypoperfusion.

  - **(4)** The ***outcomes*** are the intermediate effects of the activities, e.g., length of stay/patient, complications/patient, cost/patient or sepsis-related mortality rates
  - **(5)** ***Impact*** refers to macro numbers, e.g., institutional, healthcare system, state or national effects in terms of decline in sepsis-related mortality rates and costs

Teaching Tip
Refer to Fig. 23.3. Assessing performance, using United Nations Development Program terminology, associated with results-based management (RBM).

- **e.** To the extent that the UNDG outcome terminology adds clarity to the way in which we, as advanced practice nurses, articulate and measure outcomes, then we should consider its use clinically, as described above, and educationally

Teaching Tip
Provide the example, the current Saint Louis University DNP capstone project, as described in Fig. 23.2, is aimed not just at improving process outcomes, but at reducing patient risk or improving what it refers to as patient outcomes. However, clarity is increased if it were to state that the DNP project aim is to reduce patient risk (or improve patient outcomes) and to impact the healthcare system positively, where the system may be a clinic, a nursing unit, an institution, a healthcare system, state or national healthcare statistics.

- **f.** Matrices are powerful structures for presenting information about two discrete but related sets of data, even though they do not capture depth the way a cube or other multidimensional structures do
  - **(1)** For our purposes here, in this chapter, a three-dimensional rectangle will suffice in making this point (Fig. 23.4)
  - **(2)** Its three dimensions (height, length, and width) display the
    - **i.** Healthcare technology knowledge
    - **ii.** Organizational science
    - **iii.** And nursing science and practice domains within a BSN to DNP curriculum
  - **(3)** These may be considered advanced practice knowledge domains
- **g.** As in any taxonomy, domains have classes
  - **(1)** The classes within each of these domains are course competencies
  - **(2)** Each may be cross-indexed with its AACN Doctoral Education Essentials for Advanced Practice
  - **(3)** Just as the AACN aligns DNP education with practice, so does Fig. 23.4
  - **(4)** It is not as if the DNP student simply progresses through a curriculum to achieve DNP status as in Fig. 23.1
  - **(5)** Nor is it as if knowledge is tracked as in the matrix in Fig. 23.2
  - **(6)** Rather, the DNP student is introduced to, is immersed in, and progresses through an advanced practice program of learning
  - **(7)** Although at a certain point, a DNP degree will be conferred, the conferral just further commits the graduate to lifelong growth within the same knowledge and competency domains: advanced nursing science and practice, organizational science and healthcare technology

Teaching Tip
Refer to Fig. 23.4. Saint Louis University Doctor of Nursing Practice Curriculum displayed as a three-dimensional structure.

- **h.** Technologic science courses are clinical informatics courses, epidemiology, biostatistics, and patient care technology
- **i.** Organizational/population science courses are healthcare policy, leadership, healthcare ethics, healthcare delivery systems, organizational climate, and interprofessional teamwork

j. Nursing science courses are advanced physiology, pharmacology and physical assessment, evidence-based practice. I. principles and II. Applications; health and wellness promotion; clinical (illness and disease) management courses; interprofessional collaboration, including quality improvement methods; and the capstone project

Teaching Tip
Note: the care of diverse populations and cultural sensitivity is threaded throughout all three dimensions.

k. This academic structure reflects knowledge and competencies specified in four main documents
  (1) The Essentials of Doctoral Education for Advanced Practice nursing
  (2) 2012 Core Nurse Practitioner Competencies, identified by the National Organization of Nurse Practitioner Faculties
  (3) American Nurses Credentialing Center test outlines, such as that of the 2013 family nurse practitioner outline
  (4) National Council of State Boards of Nursing APRN Advisory Group and the APRN Work Group, 2008 Consensus Model for APRN Regulation: Licensure, Accreditation, and Certification and Education

l. These documents do not refer to three domains of advanced practice nursing knowledge at the doctoral level
  (1) Rather, with remarkable consistency, they refer to similar, if not identical, knowledge areas and related competencies
  (2) We merely group these knowledge areas and competencies into three main categories and create the domains (Fig. 23.4)
  (3) It is not inconceivable that these three knowledge domains become basic department within Schools of Nursing

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Knowledge Structures Facilitate the Creation of Advanced Practice Internet Databases

1. Overview
  a. Each domain is composed of classes or content areas
    (1) Each of these can be developed into its own database of hyperlinks to reliable and accurate sources of information
    (2) Let's take the ***healthcare technology domain*** first
    (3) It has two classes, at present: *Informatics* and *health technology research, development, and entrepreneurship*
  b. Informatics for the advanced practice nurse does not go into the same depth, nor breadth of content as do informatics courses for the informatics specialist
    (1) Table 23.1 shows the kinds of content to be included in advanced practice informatics courses
    (2) At the doctoral level, the primary intent of informatics is to support evidence-based practice and quality improvement initiatives to improve patient outcomes and reduce risk
    (3) Table 23.1, like the other tables in this chapter, is intended to be a springboard for practice learning

Teaching Tip
Provide the example, there is only one electronic health record Web site listed. It is the federal HealthIT Web site.

    (4) There is no mention of Web sites dealing with vendor and IT issues, documentation, efficiency, safety, standards, or security issues—nor even of free, cloud-driven electronic health software now available
    (5) The Web site outlines content areas
    (6) In other words, each content area is capable of being further developed into its own information/knowledge Web
    (7) The authors place epidemiology and biostatics within the informatics section of the healthcare technology domain
    (8) Each represents f analytical knowledge basic to the measurement of improvement in healthcare processes and patient outcomes or reduction in patient risk, let alone the measurement of the larger impact such improvements have on society
  c. Table 23.1 also presents information on the health technology research, development, and entrepreneurship
    (1) Notable is the work being conducted at the University of Wisconsin in the creation of the Living Environments Laboratory and at the University of Pennsylvania in the creation of a Health Technology Incubator, where nurses are developing innovative
      i. Point-of-patient contact devices/sensors
      ii. mHealth apps
      iii. Simulations
      iv. Social media/Web-based uses
      v. And newer software/systems
    (2) Table 23.1 identifies AHRQ Web sites, which support technical innovations to enhance health in every aspect of life today
    (3) Table 23.1. Selected Web sites illustrating healthcare technology content within its two classes
      i. Informatics and healthcare technology research
      ii. Development
      iii. And entrepreneurship
  d. The ***organizational science domain*** has several classes: healthcare ethics, policy (advanced practice nursing and healthcare), healthcare delivery systems, leadership, epidemiology, and biostatistics)
    (1) By definition, classes within a domain should be discrete with no overlap
    (2) In the biological and chemical world, this is possible

  - **(3)** Within the healthcare and nursing education and practice worlds, the classes are not discrete
  - **(4)** They represent areas of focused practice or education, but overlap is substantial
- **e.** Just as health technology research, development and entrepreneurship is exploding within the health technology domain, policy is exploding within the organizational science domain
  - **(1)** Within advanced practice, two converging policy thrusts include the
    - **i.** IOM report on the Future of Nursing, with its message that nurses practice to the full extent of their education and training
    - **ii.** And the 2008 APRN consensus model promoted by the National Council of State Boards of Nursing, with its intent to license as independent practitioners, those who have been properly educated and board certified within at least one of six population foci
  - **(2)** The overriding purpose of each endeavor is to increase access of the population to qualified healthcare providers and to improve the health status of the nation, which is also the purpose of the Affordable Care Act (ACA), the foundation of current healthcare policy and reform
  - **(3)** This is leadership in action
  - **(4)** For nursing, at this moment in history, the meaning and intent of leadership is transformation
  - **(5)** This transformative power of nursing leadership is acknowledged in the IOM commentary
  - **(6)** Transformative leadership is advanced by the ANA and the Robert Wood Johnson Foundation in their respective support for nursing leadership development
  - **(7)** The study of transformative leadership is one of the pillars of advanced practice nursing and education
- **f.** Healthcare ethics and healthcare delivery systems are inextricably intertwined to the extent that the ethics of healthcare professionals is manifest in the performance of the healthcare system
  - **(1)** Performance may be measured by degree of patient safety
  - **(2)** But also by compliance with regulations, e.g.,
    - **i.** The Health Insurance Portability and Accountability Act (HIPAA)
    - **ii.** Occupational Safety and Health Administration (OSHA), governing blood pathogen safety
    - **iii.** Clinical Laboratory Improvement Amendments (CLIA)
    - **iv.** And the CDC regarding mandatory notifiable diseases
  - **(3)** How well a healthcare delivery system performs is also a function of the model it follows

Teaching Tip
Provide the example, accountable care organizations (ACOs) are incentivized by the Centers for Medicaid and Medicare for keeping patients well.

- **g.** While nursing and medical processes and patient outcomes have been measured and while various healthcare policies have been implemented and different delivery systems tried
  - **(1)** Until now little systematic focus has been on the organizational climate of the practice or delivery system
  - **(2)** Led by Dr. Poghosyan at Columbia, a team of investigators have developed, tested, and are using an organization climate questionnaire to evaluate practice settings, including advanced practice nursing settings in primary care
  - **(3)** This section concludes with a word on interprofessional practice
  - **(4)** Healthcare practice today is a collaborative effort among overlapping teams of professionals, dedicated to the well-being of the patient and quality of care being delivered
  - **(5)** That said, it behooves all to take advantage of this goodwill as we advance health and healthcare

Teaching Tip
Refer to Table 23.2. Selected Web sites illustrating content within the classes of the organizational science domain of advanced practice.

- **h.** There are many unobtrusive measures of the transformative changes occurring in nursing today
  - **(1)** One is that this very chapter on advanced practice was previously focused on content presented in Appendix, Advanced Nursing Science and Practice Domain
  - **(2)** The content in this domain is central to advanced practice and to DNP programs, nationwide
  - **(3)** Evidence guides its practice. Its structured approach is standards based
  - **(4)** The transformative change in advanced practice
  - **(5)** While doctorally prepared professionals may be informaticists, policy experts, leaders, healthcare technologists, qualitative improvement specialists, risk managers, organizational consultants, and researchers, the doctor of nursing practice is, at core, a clinician whose clinical science is integrated with high level healthcare technology and organizational science skills
  - **(6)** There is no attempt here to diminish the core of DNP practice by relegating its database to an appendix, but rather to capture the breadth and depth of this expanded 21st-century practice, reasonably, within one chapter
- **i.** In the previous paragraph, the term “clinician” was used
  - **(1)** This term was not meant to apply to nurse practitioners, alone
  - **(2)** The clinical leader is a clinician, but one with a focus of practice different than that of the nurse practitioner
  - **(3)** Each must be allowed to practice to the fullest extent of their education and its practice parameters or scope

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Structuring and Evaluating a Database Focused on One Clinical Topic: Pain

1. Pain
- **a.** According to the Institute of Medicine report, *Relieving Pain in America* approximately 100 million people in the United States suffer from chronic pain, more than diabetes, coronary heart disease, stroke, and cancer patients combined
  - **(1)** It is estimated that pain costs in the United States are over 600 billion dollars annually in medical bills, lost productivity and missed work
- **b.** Pain is one of the only symptoms common to all specialties
  - **(1)** Pain is one of the most frequently given reasons an individual gives when seeking out a healthcare professional
  - **(2)** Pain is often undertreated
  - **(3)** The reasons for under treatment of pain include
    - **i.** Lack of formal professional education in pain
    - **ii.** Lack of knowledge regarding treatment and management
    - **iii.** Not believing a patient is in pain
    - **iv.** Not understanding the physiological and pathophysiological origins of pain and attitudinal/cultural issues
    - **v.** Not appreciating the variety of responses to pain
  - **(4)** One way of addressing at least some of these deficiencies in education is by creating an accessible and easily retrievable pain information database, organized in keeping with the ANA Standards of Professional Nursing Practice
- **c.** Six reviewers, experienced in one or more aspects of pain management, evaluated 64 Web sites, categorized within the ANA Standards of Professional Nursing Practice, according to a five-point Likert-based scale
  - **(1)** The criteria were: accuracy, authority, objectivity, currency, and coverage
  - **(2)** According to researchers the higher the "yes" score, the higher the quality of information on the Web site
- **d.** Currently, the most widely used system to evaluate the trustworthiness of a healthcare-related Web site is the HONcode (Health on the NetCode)
  - **(1)** HON is a certifying body for healthcare-related Web sites. HON uses eight criteria
    - **i.** Authoritative
    - **ii.** Complementarity
    - **iii.** Privacy
    - **iv.** Attribution
    - **v.** Justifiability
    - **vi.** Transparency
    - **vii.** Financial disclosure
    - **viii.** And advertising policy
  - **(2)** If the Web site is accepted, the seal for HON, along with the date it was evaluated, will be displayed on the home Web site page
  - **(3)** HON works in congruence with the University Hospitals of Geneva and the Swiss Institute of Bioinformatics
  - **(4)** HON, is a certifying body, used only for healthcare sites, to evaluate the site's trustworthiness
- **e.** When we evaluated our Web sites we used the five criteria according to Alexander and Tate's (1996–2005) definitions, but we went one step further
  - **(1)** We asked our expert reviewers to quantify the five criteria based on a five-point Likert scale with one being "strongly disagree" and five being "strongly agree"
  - **(2)** Each expert rated each Web site for each criterion within each of the ANA standards
  - **(3)** We held "accuracy" as the gatekeeper
  - **(4)** If a Web site did not average a 4.0 or greater from all the expert reviewers it was eliminated and not included in the database
  - **(5)** In inter-rated reliability terms, this meant that 100 percent of the raters had to score the site at 4.0 or greater
  - **(6)** Table 23.3 represents an even higher inter-rater reliability measure
  - **(7)** It includes only those with scores ≥4.80 on the 5.0 scale
  - **(8)** The Web sites are coded by the ANA Standard of Practice to which they refer
  - **(9)** More complete results are available on the Pain Database page
  - **(10)** NLINKS stands for Network for Language in Nursing Knowledge
- **f.** Structuring knowledge-based data, even when framed according to ANA practice standards, does not guarantee that the structure or information will be used as designed or, even more importantly, change practice or patient outcomes
- **g.** If structured information is to be used, it needs to be available, its usage tracked, within-system patient outcomes and ultimately population-based impact evaluated
  - **(1)** The availability and use of such structured pain information for clinical decision support purposes may be tracked using electronic healthcare record data from within a large healthcare system
  - **(2)** Only when we track this within-system changes in patient outcomes as a function of information use do we advance healthcare
  - **(3)** Only when we track changes across systems of healthcare can we measure the Impact on pain reduction in the population as a whole, increases in return-to-productivity, and decreases in healthcare costs
  - **(4)** Structuring and evaluating the accuracy and overall value of clinical information on pain is one among many steps forward

2. The **advanced nursing science and practice domain** (Appendix)
   - **a.** Is unchanged insofar as it remains divided into categories according the ANA Standards of Practice
     - **(1)** It is changed insofar as two new emphases are added
     - **(2)** The definition of "diagnosis" is expanded to include the documentation of
       - **i.** Illness diagnoses
       - **ii.** Nursing diagnoses
       - **iii.** Additions/deletions to problem list
       - **iv.** Preventive care needs (including evidence-based screenings and vaccinations)
       - **v.** Medication reconciliation and adverse even review conclusions
       - **vi.** Health education needs
       - **vii.** And functional assessment conclusions
     - **(3)** Experienced clinical say, "We do this"
     - **(4)** They report that such needs are addressed verbally or that such needs are met by computer work-a-rounds as they prefer their own methods to computer-generated evidence-based alerts or download.
     - **(5)** The goal of electronic health records is to standardize care so that evidence based practice is delivered and documented, and hence healthcare outcomes are improved and costs reduced
     - **(6)** If evidence-based care is not standardized across healthcare system, healthcare will not be advanced
     - **(7)** If documentation is deficient, then when electronic health records are reviewed in the aggregate, the value of advanced practice is underestimated
     - **(8)** Nursing, is not visible unless it is documented
   - **b.** Another section that is added in this edition's database of Internet tools for advanced practice is a section on opioid-related adverse events and deaths
     - **(1)** That there is a problem is certain
     - **(2)** That some of the remedies will increase the severity of pain in the populations is a risk
     - **(3)** Advanced practice nurses must help lead the healthcare and nursing communities to evidence-based solutions
     - **(4)** It is hoped that the section on opioid therapy in Appendix will assist in this endeavor

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Articulate support for the advanced nursing, healthcare technologic, and organizational science domains of advanced practice
- Create structures that reflect the integration of doctor of nursing practice knowledge/competencies between and within domains
- Select reliable and appropriate Web-based content within advanced practice knowledge/competency domain categories

Teaching Tip

Ask the students to define the keywords

- Advanced practice
- Nursing
- Reflection
- Structures
- Domain(s)
- Categories
- Healthcare
- Technology
- Informatics
- Organization
- Knowledge
- Competencies
- Curriculum
- Education
- Database
- Pain
- Management

CHAPTER REVIEW QUESTIONS

Question 23.1: What part of the Future of Nursing IOM report in 2010 relates to the Focus on Scope of Practice?

- **a.** The part that calls for the States to remove inconsistent barriers to practice and the federal government to advance the reforms needed through the work of Congress and regulatory agencies
- **b.** The part that calls for all healthcare professionals to deliver safer and more effective care to patients
- **c.** The part that calls for all advanced practitioners to be more cost effective
- **d.** The part that calls for enhanced monitoring of advanced practitioners practices

Question 23.2: The Future of Nursing IOM report led to what report that translated the action to state and local levels?

- **a.** The Quality Chasm Report that furthered the goals of improving costs in healthcare

b. A "Campaign for Action," initiating action at local, state, and national levels, communicate the call to action, and monitor results

c. An IOM report on the future of consumer care

d. None of the above

Question 23.3: What non-nursing coalition has been advancing the role of the nurse practitioner in providing care to Americans?

a. The AMA actions to further nurse practitioners in providing healthcare

b. The AAFP actions to further nurse practitioners in providing healthcare

c. The 2014 Miller Center Report on Cracking the Code on Health Care Costs. Its recommendations include eliminating within-state scope of advanced practice barriers and establishing a place at the healthcare cost table of all stakeholders, including all providers (physician and nonphysicians alike)

d. There are no non-nursing coalitions helping to advance the role of nurse practitioners

Question 23.4: What is one healthcare area that costs the United States are over 600 billion dollars annually in medical bills, lost productivity and missed work?

a. Diabetes

b. Coronary Artery Disease

c. Chronic Pain

d. Cancer

Question 23.5: The criteria used to evaluate the content in the ANA Standards for Professional Practice on Pain are?

a. The criteria were: accuracy, authority, objectivity, currency and coverage

b. The criteria were: content validity, reliability, organizational sponsorship, endorsed by the drug companies

c. The criteria were: cost effectiveness, efficiency and effectives

d. The criteria were the ability to achieve outcomes at a reduced cost

Question 23.6: The most widely used system to evaluate the trustworthiness of a healthcare-related Web site is ____________?

a. The most widely used system to evaluate the trustworthiness of a healthcare-related Web site is the HON (Health on the NetCode)

b. The most widely used system to evaluate the trustworthiness of a healthcare-related Web site is the ANA Scope of Professional Practice

c. The most widely used system to evaluate the trustworthiness of a healthcare-related Web site is the Standards of Excellence for the World Wide Web

d. The most widely used system to evaluate the trustworthiness of a healthcare-related Web site is the Wikipedia

Question 23.7: Four of the most highly scored information Web sites on pain for advanced nurse practitioners are?

a. AHRQ Guidelines for Pain Assessment, CDC Guidelines for Pain Assessment, National Pain Association Guidelines for Pain Treatment, The Association of Pharma recommendations for Pain assessment and treatment

b. IASP Pain Classification, FDA Drug Safety Communication, City of Hope Pain and Palliative Resource Center, and CDC Prescription Painkiller Overdoses in the United States

c. AHRQ Guidelines for Pain, the CDC Guidelines for Pain, the National Institutes of Health Pain Center, and the National Institute of Nursing Research Advanced Pain Resource Center

d. Robert Wood Johnson Pain communication center, the CDC Prescription Painkiller Overdoses in the United States, and the AHRQ Guidelines for Pain

Question 23.8: The vision for the Electronic Health Record use in Advanced Nurse Practice is _______?

a. The vision of Electronic Health Record is to standardize care so that evidence-based practice is delivered and documented so that healthcare outcomes are improved and costs reduced

b. The vision of the Electronic Health Record is to interface with all of the recommended Web sites for nurse practitioners to utilize in diagnosis and treatment

c. The vision of the Electronic Health Record is to allow flexibility of the Nurse Practitioners to guide their own practice at individual sites

d. The vision of the Electronic Health Record is to have open-ended text documentation for all levels of nurse practitioner encounters

Question 23.9: True or False. Nursing, direct care or advanced, is not visible unless it is documented.

Question 23.10: True or False. There are no treatments that actually increase the pain in patients.

ANSWERS AND EXPLANATIONS

Question 23.1: (a) The Future of Nursing that relates to the Focus on Scope of Practice for the States to remove inconsistent barriers to practice and the federal government to advance the reforms needed through the work of Congress and regulatory agencies.

Question 23.2: (b) The Future of Nursing report led to a "Campaign for Action," a joint endeavor by AARP and the Robert Wood Johnson Foundation. Actions were directed toward building a stakeholder base, initiating action at local, state and national levels, communicate the call to action, and monitor results.

Question 23.3: (c) The 2014 Miller Center Report on Cracking the Code on Health Care Costs. Its recommendations include eliminating within-state scope of advanced practice barriers and establishing a place at the healthcare cost table of all stakeholders, including all providers (physician and nonphysicians alike).

Question 23.4: (c) It is estimated that pain costs in the United States are over 600 billion dollars annually in medical bills, lost productivity and missed work.

Question 23.5: (b) The criteria were: accuracy, authority, objectivity, currency and coverage.

Question 23.6: (a) The most widely used system to evaluate the trustworthiness of a healthcare-related Web site is the HON (Health on the NetCode).

Question 23.7: (b) IASP Pain Classification, FDA Drug Safety Communication, City of Hope Pain and Palliative Resource Center, and CDC Prescription Painkiller Overdoses in the United States.

Question 23.8: (a) The vision of Electronic Health Record is to standardize care is standardized care so that evidence-based practice is delivered and documented so that healthcare outcomes are improved and costs reduced.

Question 23.9: True. Nursing, direct care or advanced, is not visible unless it is documented.

Question 23.10: False. Some of the remedies will increase the severity of pain in the populations.

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Nursing Informatics in Retail Clinics

• OBJECTIVES

1. Understand the evolution of the retail industry and the need for innovation.
2. Understand the mission and the foundational characteristics of affordable, high quality, easily accessible healthcare.
3. Understanding of the key services offered and how clinics operate and adjust services to meet consumer needs.
4. Understand the use of technology and innovation to validate the quality of care delivered in retail clinics.

• KEY WORDS

Retail clinics
Convenient care clinics
Quality/HEDIS
EHR
Patient engagement

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: What is a retail health clinic? What type of health services do you think the clinic would offer? Where would you expect to find a retail clinic? Who would staff the clinic? What type of health information technology would you expect to find in a retail clinic? Why would someone seek healthcare services in a retail clinic?

For a WIIFM statement, say to the class, "The purpose of this chapter is to provide an introduction and overview of how retail clinics are a disruptive innovation because they operate outside conventional physician offices, disrupting existing models of primary care. Moreover, from their inception retail clinics have viewed themselves as one member of the care team that a patient can access to meet their healthcare needs. Furthermore, when the patient utilizes the right care venue with the appropriate level provider and technology facilitates the communication necessary for coordinated care all involved parties—patient, retail clinic and PCMH benefit. Information technology is the foundation upon which the retail clinic business has been built. This foundation enables retail clinics to rapidly respond to market demands of its consumers and care delivery partners." As a nurse, it is important to understand the importance of the retail clinic in the delivery of healthcare services as the use of information technology.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Overview

1. Desktop computers replacing mainframes, smartphones displacing desktop computers and laptops, e-mail ousting "snail" mail as the communication method of choice around the world
    a. These are more than just examples of how technology has advanced to bring us smarter, faster, more usable ways to live and work

   - **b.** These are also examples of disruptive innovations
   - **c.** Disruptive innovation can occur to fulfill a need in a market that traditional services have been unable to satisfy
   - **d.** These innovations often take a market by surprise just like the retail clinic movement did to the traditional healthcare landscape
   - **e.** Retail clinics meet the definition of disruptive innovation in that they are a new way of delivering an existing service or product that enables a larger population of skilled but less expensive people to do in a more convenient, less expensive setting things that historically could be performed only by expensive specialists in centralized inconvenient locations

2. Disruptive innovation has influenced healthcare like it has other industries
   - **a.** The current healthcare model is a business centric, not patient centric delivery approach that is not transparent or easy for the patient to navigate
   - **b.** Patients must go to the medical office at a time convenient to the physician, not necessarily the patient
   - **c.** There are few consumers who would blindly purchase a product without first asking the cost, yet this is the norm for how we access healthcare instead of the exception
   - **d.** To achieve our goals of affordable, accessible quality care changes to our healthcare delivery model are occurring
   - **e.** These changes are focused on innovations that will enable
     - **(1)** The utilization of skilled but less expensive healthcare personnel to provide appropriate levels of care
     - **(2)** A shift away from traditional healthcare venues like hospitals and physician offices into other lower cost and/or more accessible settings like community-based retail clinics
     - **(3)** Information technology to support individualized patient care, coordination of care across multiple care venues, and accessibility to care via new technologies like telehealth and eHealth
3. A growing as well as an aging population with multiple chronic disease care needs and the expanded insurance coverage, as a result of the Affordable Care Act, are frequently cited as the causes of the expanded need for primary healthcare services
   - **a.** While demand for healthcare is growing the traditional workforce, primary care providers (PCPs), to meet this demand are not keeping pace
   - **b.** HRSA projects a 16 percent increase in the demand for primary care physicians by 2020 which will not be offset by the projected 8 percent increase in supply
4. The projected shortage of primary care physicians may be mitigated by the anticipated growth in the supply of Nurse Practitioners and Physician Assistants
   - **a.** By 2020 the number of NPs delivering primary care is projected to increase by 30 percent
   - **b.** The number of Physician Assistants delivering primary care is anticipated to increase by 58 percent
   - **c.** Whether these growing provider groups can meet our nation's demands for primary care is dependent on whether their roles can be successfully integrated into the primary care delivery system and whether they will be allowed to practice at the highest level of their education and licensure
5. The literature suggests that simply improving the supply of PCPs will not meet the market demand for primary healthcare
   - **a.** Obsolete delivery models that don't address patient needs for accessible, convenient cost effect care as well as the availability of the workforce delivering that care create additional barriers to delivering primary care services
   - **b.** To meet the demand for primary care services calls for a change to existing care delivery models
   - **c.** This change will be facilitated by clinical innovation that challenges or disrupts the status quo and information technology that improves provider productivity and enhances the quality of care

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Retail Clinics: Disruptive Innovation for Primary Healthcare Delivery

1. Convenient, coordinated, high quality, and affordable healthcare services remain unmet needs for many Americans
   - **a.** Retail clinics, also known as convenient care clinics, are a disruptive innovation designed to address these unmet needs
2. Despite healthcare reform the rising cost of healthcare is a frequently identified issue for patients
   - **a.** While healthcare reform may alleviate this concern to some extent for the uninsured, insured workers out of pocket expenses for healthcare have also continued to increase
   - **b.** As a result many patients with healthcare coverage are finding healthcare increasingly unaffordable
3. Inconvenient and limited access to healthcare is another source of frustration for many patients
   - **a.** Planning activities in our lives mean juggling time for work, family, education, and other related activities
   - **b.** Technology has facilitated our daily activities bringing to the average user the ability to access information, schedule and plan activities, work, and shop, and even learn online
   - **c.** Consumers and businesses have embraced technology as a means to better use of time and resources and accessibility to services
   - **d.** This improved accessibility to products and services is available to virtually every facet of our lives except healthcare
   - **e.** When we need access to healthcare it is not necessarily something easily planned for
   - **f.** Being able to see a physician where and when we want to is often difficult
   - **g.** As a result, patients either wait longer than desirable to see their primary care physician or access care through already overburdened and not necessarily appropriate venues such as emergency departments

  - **h.** Fragmented care is also a possibility if a patient's PCP does not have the ability to access the record of healthcare provided outside his/her office

4. The inception of retail clinics came from consumer demand for convenient, easily accessible, affordable, quality healthcare

  - **a.** The first retail clinics opened their doors in 2000 and since that time have grown to more than 1400 clinics
  - **b.** Clinics are usually located in community-based retail locations such as drugstores, food stores, and other retail settings and offer a range of services
  - **c.** Given their retail and community-based locations, most clinics are open 7 days/week, 12 hours/day, 360 plus days/year
  - **d.** No appointments are necessary, even though some operators have appointments for some services, and walk-ins are welcome
  - **e.** Nearly half of retail clinic visits take place on weekends and during weekday hours when primary care offices are typically closed, reflecting their convenience and consumer focus
  - **f.** Most clinics see patients 18 months or older and visits take an average of 15 to 25 minutes
  - **g.** Visits range from preventative services such as sports physicals, wellness screenings, and vaccination to the majority of visits being acute episodic in nature such as otitis media, sinusitis and urinary tract infections
  - **h.** Retail clinic costs are very transparent to the patient
  - **i.** Lower overhead costs are associated with retail clinics due to reduced administrative staffing needs, the utilization of NPs and PAs and the smaller physical footprint needed for clinic operations
  - **j.** Lower overhead costs are also reflected in lower fees for similar care services in comparison with traditional primary care practices
  - **k.** Services and their associated fees are transparent at the clinic posted on LCD screens and on check-in Kiosks, they are also posted on company Web sites, so that patients have the information they need to make informed choices
  - **l.** Also readily available either on the clinic Web sites or in the retail establishments are locations and hours of operations for all clinics in a geographic area and nationally
  - **m.** While most clinic visits are handled on a walk in basis, some operators additionally allow for scheduled appointments for clinic visits via the clinic Web sites or a centralized call in location

5. Between 2007 and 2009 there was a six fold increase in the number of visits to retail clinics

  - **a.** Several studies have been conducted to identify factors that would cause patients to favor using retail clinics over a traditional PCP
  - **b.** Convenience, decreased wait time and lower cost of care were the primary reasons patients were "voting with their feet" by seeking care at retail clinics
  - **c.** Analysis of patient surveys regarding their experience with their retail clinic visit found 51 percent of patients would have used an emergency room or urgent care center had the retail clinic not been an option for a visit
  - **d.** Survey Respondents in a study examining provider preferences respondents preferred to see physicians versus alternate providers (NPs, PAs) if the wait time was equal
  - **e.** However, if wait times were different most preferred to see the NP or PA instead of waiting for an appointment with the physician

6. The retail clinic model is primarily staffed by Nurse Practitioners and to a lesser extent by Physician Assistants

  - **a.** Physicians collaborate with clinic providers in accordance with state law and regulation
  - **b.** Unlike physician offices, however, retail clinics are a single provider model where one provider handles all aspects of a patient's visit including
    - **(1)** Registration
    - **(2)** Diagnosis
    - **(3)** Treatment
    - **(4)** Fee collection
    - **(5)** Discharge
    - **(6)** And follow-ups
  - **c.** Some clinics may also have ancillary help, such as a medical assistant, to assist with some of this process depending on the typical volume of patients seen in the clinic

7. From their inception, retail clinic operators planned for the use of technology as part of their clinic operations to address the lack of administrative and ancillary support typically found in PCP office visits

  - **a.** A typical physician office has many staff managing the patient's end to end visit
  - **b.** An office visit
    - **(1)** Usually begins with administrative staff registering the patient
    - **(2)** Accessing the patient charts to update demographics and insurance information,
    - **(3)** Determining insurance eligibility
    - **(4)** Before the patient is handed off to medical staff for initial screening (height/weight/vital signs, documentation of chief complaint
  - **c.** The patient is then ready to see the doctor/provider and waits for his/her examination, diagnosis, and subsequent treatment if indicated
  - **d.** The provider's administrative or medical staff may then perform additional follow-ups such as referrals, scheduling for other visits, and collect the fee for service
  - **e.** This same visit workflow exists in retail clinics, but is facilitated by
    - **(1)** A variety of integrated practice management
    - **(2)** EMR
    - **(3)** Decision support
    - **(4)** And patient facing technologies in order to meet the goals of convenient, cost effective quality care

8. Retail clinics have always been committed to quality of care

  - **a.** In 2006 retail clinic operators met to form an association, the Convenient Care Association (CCA)

- **b.** The association and industry stakeholders placed a high priority on developing the ten CCA Quality and Safety Standards for the industry
  - **(1)** The first standard requires all clinic personal to be credentialed and licensed providers
  - **(2)** Second, clinic operators demonstrate their commitment to high quality care through peer review collaborating physician review and use of evidence-based practice guidelines
  - **(3)** Third, all clinic operators must use electronic health records (EHRs), which contribute to efficiency, accuracy and continuity of care
  - **(4)** Clinic providers must establish relationships with local physicians, including PCPs, specialists, and emergency service providers, to ensure appropriate patient care in the event a patient presents with a condition outside the scope of the clinic's capability to address
  - **(5)** Fourth, in the event a patient does not have a PCP, the patient will be encouraged to establish a relationship with a PCP
  - **(6)** Fifth, the clinics will adhere to industry standards and regulations for healthcare providers such as OSHA, CLIA, and HIPAA
  - **(7)** Sixth, clinics are committed to assisting the patient to manage their health and wellness by providing patient education and counseling and a copy of their records for the encounter
  - **(8)** The seventh standard addresses the importance of EHRs in supporting the continuity of care for a patient
    - **i.** EHR used in the clinics allows for the sharing of patient information with the patient's designated healthcare providers electronically via a direct interface using industry standards (HL7) and/or health information exchanges
  - **(9)** The eighth and ninth standards address a safe clinic environment and emergency procedures are in place to ensure the safety of the patient
  - **(10)** The tenth standard requires transparency of the cost of care so that the patients can make informed choices about their care
- **c.** These standards demonstrate the commitment to delivering quality care on the part of retail clinic operators, as well as the value they place on technology to achieve their quality goals

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Technology Use in Retail Clinics to Deliver Quality Care

1. Overview

- **a.** Providing healthcare is a labor intensive, knowledge intensive, skill intensive, and time intensive activity
- **b.** In a retail clinic one provider one clinic model information technology is used to streamline workflows and sharing of data across a variety of applications in order to reduce unnecessary work and streamline the time to deliver care
- **c.** EHRs present to providers a longitudinal view of the patient's record and appropriate evidence-based clinical guidelines as well as decision support algorithms to support the diagnosis and treatment of the patient
- **d.** In retail clinics, technology supports patient self-management, practice management and clinical care delivery workflows

2. Patient self-management

- **a.** Engaging the patient in managing their care begins with empowering the patient to access their care where and when they need it
  - **(1)** The community-based locations of retail clinics bring healthcare to where patients work, shop, and live
  - **(2)** Clinic operators utilize similar models of delivery across their facilities which ensure a somewhat uniform patient experience regardless of where the patient seeks care
  - **(3)** For retail clinics with a national footprint not only can patients who travel have that experience in other parts of the country, but their patient record can also be accessed as well
- **b.** Online or mobile accessed scheduling systems are being used in many industries to assist consumers in effectively utilizing their services
  - **(1)** Consumers access scheduling systems to select convenient dates and times for services such as car repairs, haircuts, and restaurant reservations
  - **(2)** Many patients feel comfortable using appointment technology for their day to day activities and embrace the idea of using similar applications to access their healthcare services
  - **(3)** For retail clinics this means balancing the walk in model of care with allocated time slots for appointments to maintain the flow of patients in a given clinic and efficient use of clinic resources
  - **(4)** Part of any scheduling system is appointment reminders
  - **(5)** Using secure text or e-mail messaging and/or other messaging options such as telephony, patients can receive reminders of upcoming clinic appointments
  - **(6)** Reminders can increase the likelihood of the patient showing up for the visit or allow the patient to cancel the visit thus freeing up the timeslot for another patient
  - **(7)** Patient managed scheduling also provides the clinic with the first opportunity to capture patient demographic data such as patient name, age, and reason for the visit
  - **(8)** This information can then be utilized in downstream workflows and/or applications to validate the identity of the patient and inform the provider of the reason for visit prior to meeting the patient so he/she can be prepared to deliver the services based on visit reason type

- **c.** When the patient arrives at a clinic he/she utilizes a variety of technology-based applications to begin the visit prior to interfacing with the provider
  - **(1)** The patient is greeted not by an administrative staff but by kiosks and additional display hardware and applications which provide the information and instructions needed to begin the registration process
- **d.** Kiosks are used at clinics to begin the registration process and to inform the patient of wait times and approximate costs of service
  - **(1)** A kiosk is a computer terminal with a specialized software application used to capture data that support a specific business need or process
  - **(2)** The kiosk serves two purposes
    - **i.** They replace the administrative staff role in traditional practices
    - **ii.** Thus supporting the one clinic one provider model and capture visit specific data that can be shared with downstream applications such as the EHR to facilitate the provider workflows
  - **(3)** Clinics may have more than one kiosk thereby facilitating the check in process for multiple patients waiting to see the provider
  - **(4)** If the patient has scheduled the visit in advance on check in patient and visit specific data can prepopulate the kiosk to facilitate the registration process
  - **(5)** During registration the kiosk captures key demographic data about the patient, i.e., name, address, date of birth, gender, and the reason for the patient's visit
  - **(6)** From the kiosk the patient can find the fee schedule associated with the service they are seeking
  - **(7)** If the kiosk captures insurance information, the data can be used in conjunction with other financial applications to check for insurance eligibility for the service requested
  - **(8)** Usability of the kiosk is an important consideration in the registration process
  - **(9)** User experience design of the kiosk screens and flow take into account readability and comprehension as the patients move through the data capture screens
  - **(10)** Some retail clinic operators support both English and Spanish versions of the kiosk
  - **(11)** User experience design also facilitates easy edit of data entered either on the current or prior displays
  - **(12)** Consent capture and financial responsibility information (how the patient will pay for the visit) finish the registration process for the patient and places the user in the queue of patients waiting to be seen by the provider
- **e.** The patient is asked to return to the kiosk at the end of the visit to participate in a survey measuring patient engagement and satisfaction with the visit
  - **(1)** This information is used as part of a continuous quality improvement effort both personally for the provider and operationally for the clinic in general
- **f.** Queue monitors are another device frequently found in retail clinics
  - **(1)** Typically, these large screen wall mounted monitors reflect the number of patients waiting to be seen by the provider and any individual patient's place in that queue
  - **(2)** Some queue systems can calculate approximate wait times for patients based on the reasons for visits of other patients in the queue
  - **(3)** Queue monitors are a high patient satisfier for walk in clinic traffic
  - **(4)** As a patient registering for a visit you know exactly how many patients the provider must see before it is your turn and an approximate wait time
- **g.** Also found in some retail clinics is additional health information, often displayed on monitors for easy viewing in the waiting areas of the clinic
  - **(1)** Information displayed on these monitors include services provided by the clinic, fees related to the services as well as general health information such as information about vaccinations
- **h.** The final step in the registration and the queue management process is alerting the provider that a patient is waiting to be seen
  - **(1)** The system will maintain a patient queue list that the provider can access and review prior to meeting the patient
  - **(2)** Patient data in the queue list will reflect the data entered by the patient in the kiosk
  - **(3)** The queue information helps the provider plan for the next visit and beyond, seeing the full patient load at any given point in time
- **i.** Once a provider selects a patient from the queue there are two workflows the provider must follow to successfully complete a patient visit, both of which are heavily dependent on information technology
  - **(1)** The provider must satisfy the business side of the visit, administrative, billing, reporting, etc. functionality typically defined and supported by practice management software
  - **(2)** The provider must also be able to capture relevant clinical information, diagnosis and treatment plans for a patient, functionality typically defined and supported by EHRs
  - **(3)** In a one clinic one provider model these workflows are intertwined and the information technology that supports the flows must be integrated as well

3. Practice management

- **a.** Retail clinics utilize technology to support several practice management tasks. Integration of patient demographic data captured in the kiosks feeds the next step in the visit process which is the capture of patient insurance and financial information
  - **(1)** Several input devices can be used to capture this data
  - **(2)** Manual entry of insurance information and scanning of patient insurance documents are the two most common data entry techniques
  - **(3)** This implies a scanning device must be available to the provider that is capable of capturing the data from insurance documents clearly and shared with downstream financial applications to support the visit billing process

- **(4)** As more insurers utilize "virtual insurance card" new input devices will be needed by the clinics to capture insurance information from patient smartphones or other mobile devices
- **(5)** The ability to read barcodes or sync with these devices from clinic hardware is an upcoming challenge for retail clinics as these virtual insurance cards become more common

b. Once captured the insurance data is shared with an eligibility and verification system

- **(1)** If the service is not covered by the insurer the patient is responsible for payment and is informed accordingly
- **(2)** The ability to capture and verify eligibility for insurance must occur for all insurance carriers for the patient
- **(3)** If there is a payment due by the patient the system also manages prepayment processing to capture payment due for the services provided
- **(4)** The insurance capture and prepayment processing occur prior to the patient being examined
- **(5)** Well integrated concurrent processing of the various steps helps to move the patient through the insurance data capture phase of the process quickly

c. Administrative management tasks occur at various milestones throughout the clinical evaluation and documentation of the patient's visit

- **(1)** Once the patient exam has been conducted and a diagnosis and treatment plan identified the system facilitates billing functions including determination and selection of visit charges and codes, collection of payment due

d. Evaluation and Management Coding, also known as E&M Coding, is the standardized medical billing process for patient encounters

- **(1)** Retail clinics also follow the E&M coding process for their patient encounters
- **(2)** The E&M codes are based on the American Medical Association's CPT or Current Procedural Terminology codes
- **(3)** To correctly code a visit per the standard the information system utilizes an algorithm that takes into account
  - **i.** The documented data for the patient's health history (history of present illness, review of systems, past, family, and social history)
  - **ii.** Physical exam findings and the level of medical decision making on the part of the provider needed to address the patient's healthcare issues

e. The more complex the patient's health history or the more detailed the physical exam may cause a more involved decision making process on the part of the provider

- **(1)** If this is the case the provider can code the visit to reflect that complexity and be compensated for the level of work needed to address the patient's issues
- **(2)** Rules can be applied to clinical documentation that facilitates this coding process by suggesting billing codes to the provider based on documentation in the EHR
- **(3)** While it is always up to the provider to select the correct billing code, the system is using documented data to determine, based on standard E&M coding logic, the most likely billing code
- **(4)** If the provider believes the code is too high or low for the patient's encounter it is an opportunity to revisit the documentation to determine if clinical information accurately reflects the patient's status
- **(5)** Automating the calculation process facilitates assigning the correct billing code for the encounter

f. One of the final steps in any practice is collecting payment from the patient

- **(1)** How the patient prefers to pay for the visit is first captured in registration with the kiosk
- **(2)** If the patient is insured that information along with the additional insurer data (i.e., copay) is carried forward to a final billing process step
- **(3)** The system determines fees for the services provided and calculates the bill for the patient
- **(4)** A bill is generated and payment calculated based on preferred payment method of the patient taking into account copays or other payment options

g. Integration of this information with downstream financial billing systems allows for the correct billing of insurers, if applicable, for that visit as well as follow up billing to patients for costs not covered by insurers

h. To manage the administrative practice components of retail clinics requires capturing and processing patient demographic, financial and clinical data

- **(1)** Clinical data capture occurs in the EHR utilized by the retail clinics
- **(2)** These EHRs facilitate data integration with internal (i.e., billing), and external (i.e., HIEs, Lab, etc.) to achieve continuity of care for the patient

4. Clinical documentation management

a. EHRs are fundamental to the success of the retail clinics model of care

- **(1)** Like all practice EHRs, those developed for retail clinics, support the
  - **i.** Assessment
  - **ii.** Diagnosis
  - **iii.** And treatment workflows of the provider
- **(2)** The goal of the retail EMR
  - **i.** Is to help providers practice autonomously
  - **ii.** Streamlining administrative functions
  - **iii.** While suggesting clinically appropriate actions generated from evidence-based practice guidelines and clinical documentation

b. All retail clinic visits begin with documentation of a core set of clinical data related to a patient's health history (past medical, family, social, and procedure), allergies, and medication and immunization history

- **(1)** This core information is captured for each patient on initial visit to the clinic and retrieved and updated as needed in subsequent encounters

    (2) This data is used as input to rules that drive suggested actions to a provider and focused documentation templates
    (3) Historically, retail clinics have provided a defined scope of services relative to acute episodic illness (i.e., sinusitis, urinary tract infections) and wellness activities (i.e., vaccinations)
    (4) This emphasis is reflected in the retail EMR with a structured assessment process around commonly seen clinical problems
    (5) Focused assessment templates, i.e., vaccination specific, upper respiratory focused, etc., are created that drive data collection for a patient's problem
    (6) Rules are run on the data and associated values collected via these focused assessments to suggest treatment plans and patient education documentation as well as generate billing codes and provider follow up tasks
    (7) To complete the billing process providers must be able to assign the correct ICD code(s) for a clinical encounter
    (8) In traditional office practices diagnosis coding is usually done by coding experts
    (9) These experts review physician charts and assign the correct diagnosis code based on clinical documentation
    (10) In retail clinics coding assistance is built into the EHR system
    (11) Robust search functionality allows a provider to quickly find and select a code for the encounter
    (12) Quick pick lists of commonly used codes or the ability to save favorite codes facilitate the code selection process
    (13) As the country moves to utilizing ICD-10, the enhancements to EHR search as well as clinical documentation functionality will reflect the increased specificity of the diagnosis codes

  c. As part of the diagnosis and treatment plan, a provider may need to order additional tests and or medications to treat the patient's problem
    (1) The retail EHR will utilize industry standards to transmit orders from the system to external applications such as lab and radiology systems
    (2) In turn, these systems will result back to the EHR the findings for the patient
    (3) The system integrates these externally sourced results into the patient record for review by the provider
    (4) System generated tasks alert the provider that follow-ups are required for a patient ensuring timely action occurs
    (5) e-Prescribing or electronic prescribing is a technology by which a provider can electronically write and send prescriptions to a pharmacy from their EHR
    (6) e-Prescribing has had a dramatic impact in improving the quality of patient care
    (7) A recent study of physicians in community-based office practices found 50 percent lower error rates for the practice one year after adopting an e-prescribing system
    (8) For retail clinics e-prescribing is integrated into the EHR and provides many benefits to the patient
    (9) e-Prescribing allows the provider to access a patient's benefit information and choose medications that are covered by the patient's insurance provider
    (10) When a provider orders a medication drug interaction checking occurs and if a contraindication is found alerts the provider of the problem
    (11) e-Prescribing also allows a provider to access a patient's medication history
    (12) This information facilitates the medication reconciliation process for the patient as well as informs the provider of potential patient heath issues
    (13) e-Prescribing systems also allow the provider to route the prescription to the patient's pharmacy of choice
    (14) An electronically transmitted prescription removes safety issues that occur with handwritten prescriptions and saving time in the prescribing process

  d. One of the quality standards all retail clinics are committed to is sharing a discharge summary of the encounter with the patient's PCP to ensure continuity of care
    (1) If the provider's system is capable the discharge summary can be transmitted electronically to their EHR in HL7
    (2) The retail EMR is also capable of an integrated faxing solution, e-faxing the discharge summary to provider's incapable of receiving it electronically
    (3) Reporting of immunizations to state registrations is mandated in many states
    (4) The retail EHR is capable is able to support that regulatory mandate via standardized interface transactions

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Retail Clinic Role in Patient Centric Care

1. Overview
  a. The healthcare reform movement hopes to achieve its goals of quality care at reduced costs through coordinated primary care delivery systems and promotion of medical homes
    (1) Accountable care organizations (ACOs) are networks of providers with unified governance that assume risk for the quality and total cost of the care they deliver
    (2) Common strategies ACOs employ to achieve these goals are improved care coordination, use of nonphysician providers such as nurse practitioners and other health professions, the formation of patient-centered medical homes (PCMHs) and the use of information technology

b. PCMH is being promoted as the future of primary care practice
  (1) Retail clinics are well positioned to become a key component of ACOs and PCMH
  (2) Clinics, through their network of community-based sites, can identify primary care needs of the newly insured population
  (3) Closing the gaps in care for these patients occurs when the clinic providers help the patients find a medical home
  (4) Affiliations between retail clinics and community-based providers facilitate referrals to PCMH and extend the reach of PCMH as they utilize retail clinics as treatment options
  (5) These affiliations also have the potential to expand the retail clinic's scope of services, for example, chronic disease management, as retail clinics partner in the management of the patient's health with PCMH

c. Retail clinics and PCMH will utilize information technology to manage care across their separate but linked venues
  (1) Technology will allow retail clinics and PCMH to share patient information, coordinate care across different providers and better involve patients in the healthcare process
  (2) There are several IT capabilities, retail clinics have in common with PCMH to deliver coordinated patient care
  (3) Utilization of EHRs enables documentation and tracking of patient conditions as well as coordination of care through shared information

d. Clinical decision support systems improve the decision making of providers, reduce medication errors through e-prescribing and facilitate the use of evidence-based guidelines when incorporated into retail and practice EHR systems
  (1) Communication tools facilitate care transitions when data can be shared seamlessly between organizations via health or other data exchanges
  (2) Shared information will further strengthen a team-based approach to care, where PCPs see clinic providers as extensions of their practices, not competitors

e. As retail clinics become partners in PCMH networks additional technology needs will arise
  (1) Patient engagement tools that incorporate patient self-reported data will help clinicians manage patient conditions
  (2) Both retail clinics and PCMH will look to online or mobile applications to involve patients in their care process
  (3) Patients will continue to look for healthcare options that are convenient and new technologies such as telehealth will allow clinic and PCMH providers to either manager greater caseloads of patients and/or interact at times and places most convenient for the patient

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

FUTURE OF RETAIL CLINICS

- The rapidly changing healthcare market is providing a unique opportunity for advanced practice nurses to provide high quality, cost effective accessible care via retail clinic practices
- Retail clinics are a disruptive innovation because they operate outside conventional physician offices, disrupting existing models of primary care
- Technology, EHRs, e-prescribing, and data exchange are drivers in consumer acceptance of retail clinic services
- From their inception retail clinics have viewed themselves as one member of the care team that a patient can access to meet their healthcare needs
- Healthcare access, productivity and effectiveness can be improved through a team approach to care
- When the patient utilizes the right care venue with the appropriate level provider and technology facilitates the communication necessary for coordinated care all involved parties—patient, retail clinic, and PCMH benefit
- Information technology is the foundation upon which the retail clinic business has been built
- This foundation enables retail clinics to rapidly respond to market demands of its consumers and care delivery partners

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Understand the evolution of the retail industry and the need for innovation
- Understand the mission and the foundational characteristics of affordable, high quality, easily accessible healthcare
- Understanding of the key services offered and how clinics operate and adjust services to meet consumer needs
- Understand the use of technology and innovation to validate the quality of care delivered in retail clinics

Teaching Tip
Ask the students to define the keywords

- Retail clinics
- Convenient care clinics
- Quality/HEDIS
- EHR
- Patient engagement

CHAPTER REVIEW QUESTIONS

Question 24.1: True or False. EHRs are fundamental to the success of the retail clinics model of care.

Question 24.2: What IT tools are used in Retail Clinics to register patients and inform them of wait times and approximate costs?

a. EHR and scheduling systems
b. Personal health patient portals that register visits
c. Kiosks are used at clinics to begin the registration process and to inform the patient of wait times and approximate costs of service
d. Personal contacts with patients via telephone are used to register and inform patients when they can come in for an appointment

Question 24.3: A technology used by commercial companies that is also used in retail pharmacies to let patient's know how many people are in the queue so they can gauge the approximate wait time is?

a. Queue monitors are wall mounted monitors that reflect the number of patients waiting to be seen by the provider and any individual patient's place in that queue
b. A telephone call to the person's home is used to let patient's know their time in the queue
c. Patient care educational monitors are used to let patient's know that they have time to do some self-care prevention
d. The retail pharmacies do not use any commercial IT products that let patient's know how many people are in the queue

Question 24.4: What is the standard coding for used for patient encounters in retail clinics?

a. The LOINC Laboratory code
b. The Nursing Classification Systems recommended by ANA
c. The SNOMED Classification of diagnosis
d. The E&M coding process for their patient encounters

Question 24.5: What do the EHRs in the retail clinics support?

a. Only patient registration and charging for care
b. The assessment, diagnosis and treatment workflows of the provider
c. Retail clinical does not have any EHR documentation recording capabilities at this time
d. Only scheduling and timing of patient visits

Question 24.6: The providers in retail clinics rely on what type of evidence in their practices?

a. Dashboards provided by the commercial organizations
b. They rely only on professional judgments at the time of patient encounters
c. They are evidence based on guidelines
d. They rely on what will be paid for by the insurers

Question 24.7: What are the core content areas in the documentation in a retail clinic?

a. The health history (past medical, family, social, and procedure), allergies, and medication and immunization history
b. The chief complaints and procedures that can be reimbursed
c. The patient current medication profile only
d. The family health history only

Question 24.8: The scope of the clinical encounters in a retail clinic is generally what areas?

a. The management of chronic conditions, especially pain management
b. The toxicities of medications prescribed in their retail pharmacy
c. The acute episodic illness (i.e., sinusitis, urinary tract infections) and wellness activities (i.e., vaccinations)
d. They only do sports, camp, and school physicals

Question 24.9: True or False. For retail clinics e-prescribing is integrated into the EHR.

Question 24.10: For retail clinics to share the discharge summary with the routine provider, what technologies are used?

a. Integrating discharge summaries through HL7, fax, and telephone contact
b. Integrating discharge summaries through HL7, fax, and e-fax are options
c. There is no contact with the routine provider from the retail clinic
d. Only when the EHR is the same system that the retail clinic has, can discharge summary data be reported

ANSWERS AND EXPLANATIONS

Question 24.1: True. EHRs are fundamental to the success of the retail clinics model of care.

Question 24.2: (c) Kiosks are used at clinics to begin the registration process and to inform the patient of wait times and approximate costs of service.

Question 24.3: (a) Queue monitors are wall mounted monitors that reflect the number of patients waiting to be seen by the provider and any individual patient's place in that queue.

Question 24.4: (d) Retail clinics also follow the E&M coding process for their patient encounters. The E&M codes are based on the American Medical Association's CPT or Current Procedural Terminology codes.

Question 24.5: (b) Like all practice EHRs, those developed for retail clinics support the assessment, diagnosis and treatment workflows of the provider.

Question 24.6: (c) The goal of the retail EMR is to help providers practice autonomously, streamlining administrative functions, while suggesting clinically appropriate actions generated from evidence-based practice guidelines and clinical documentation.

Question 24.7: (a) The health history (past medical, family, social, and procedure), allergies, and medication and immunization history.

Question 24.8: (c) The scope of services relative to acute episodic illness (i.e., sinusitis, urinary tract infections) and wellness activities (i.e., vaccinations).

Question 24.9: True. For retail clinics e-prescribing is integrated into the EHR.

Question 24.10: (b) If the provider's system is capable the discharge summary can be transmitted electronically to their EHR in a HL7. The retail EMR is also capable of an integrated faxing solution, e-faxing the discharge summary to provider's incapable of receiving it electronically.

25

Care Delivery Across the Care Continuum: Hospital–Community–Home

• OBJECTIVES

1. Define the post-acute care delivery continuum and their contribution to the *Triple Aims* of increased quality at reduced costs, improved patient experience and improved population health.
2. Identify the current state of standards needed for care coordination across post-acute care delivery.
3. Describe how healthcare policy and regulations require participation of all care delivery sites including post-acute care to accomplish full care coordination.
4. Explain the current functionality and adoption of electronic health record tools available to and used by post-acute care providers.

• KEY WORDS

Care DeliveryPost-acute care
Care planning
Care plan
Care coordination
Care transition
Quality improvement
National quality strategy
Community
Inpatient-Rehabilitation Facilities (IRF)
Skilled Nursing Facilities (SNF)
Long-Term Care Providers (LTCH)
Home Health Agencies (HHA)
Hospice
Standards Development Organizations (SDOs)

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you explain the continuum of care? Can you give examples of post-acute care? What types of health information technology would be needed? Can you explain the role of the Office of the National Coordinator (ONC)?

For a WIIFM statement, say to the class, "In this chapter, we provide a detailed overview of the post-acute providers recognized and reimbursed for their care by CMS, and placed in the context of the current health reform environment. We highlight the primary entities driving reform and describe the role each plays and their area of contributions. We link the reform initiatives to reimbursement changes and describe how these payment mechanisms are driving new care delivery models that require tight integration with post-acute care providers for optimal outcomes. Informatics is front and center to health reform because care delivery system integration and care coordination require a sophisticated information infrastructure beyond where we are today. In our current state electronic health record (EHR) systems review of the post-acute industry, we emphasize the gaps in functionality needed to support standards, care transitions and coordination. Most importantly, we look at the near-future policy directions for new care delivery methods that require shared care plans, with the ability to send and receive patient information, and to generate outcome reporting.

In support of these new technology requirements, we give an update on the progress being made by standards development organizations, and specifically the work being done by the Office of the National Coordinator's (ONC) Standards and Integration Framework (S&I Framework)." As a nurse, it is important to the continuum of care including post-acute care and the role health information technology.

Class Preparation

1. Review the references and websites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet websites relevant to chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
    - **a.** This chapter focuses on a little known, often overlooked, and poorly understood segment of our healthcare system—post-acute care
        - **(1)** As decision makers in care planning and care coordination, nurses' and physicians' formal education often does not include training in these clinical settings nor is the subject covered adequately in curriculum
        - **(2)** Consequently, many health professionals carry an insufficient understanding of the post-acute care providers and how they can augment their care plan for a given patient
        - **(3)** As we move into the new health reform initiatives mandated under the Patient Protection and Affordable Care Act (ACA), a major challenge in achieving the *Triple Aims* of increased quality at reduced costs, improved patient experience and improved population health is our ability as a healthcare system "to integrate its work over time and across sites of care"
    - **b.** In this chapter, we provide a detailed overview of the post-acute providers recognized and reimbursed for their care by CMS, and placed in the context of the current health reform environment
        - **(1)** We highlight the primary entities driving reform and describe the role each plays and their area of contributions
        - **(2)** We link the reform initiatives to reimbursement changes and describe how these payment mechanisms are driving new care delivery models that require tight integration with post-acute care providers for optimal outcomes
        - **(3)** Informatics is front and center to health reform because care delivery system integration and care coordination require a sophisticated information infrastructure beyond where we are today
        - **(4)** In our current state electronic health record (EHR) systems review of the post-acute industry, we emphasize the gaps in functionality needed to support standards, care transitions and coordination
        - **(5)** Most importantly, we look at the near-future policy directions for new care delivery methods that require shared care plans, with the ability to send and receive patient information, and to generate outcome reporting
        - **(6)** In support of these new technology requirements, we give an update on the progress being made by standards development organizations (SDOs), and specifically the work being done by the Office of the National Coordinator's (ONC) Standards and Integration Framework (S&I Framework)

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Healthcare Reform

1. Overview
    - **a.** The fragmentation of the US healthcare delivery system is well documented
        - **(1)** Despite the United States having the highest spending per person of all the industrialized countries, it falls below the majority of the Organization for Economic Cooperation and Development (OECD) nations on major health indices, including having the highest rates for obesity
        - **(2)** In 2011, the United States spent $8500 per person, nearly double that of all other OECD nations and $2800 higher than the next highest, Norway
        - **(3)** Similarly, the United States has the highest spending per GDP (Gross Domestic Product) of the OECD nations, 17.7 percent compared to the next highest country, the Netherlands, at 11.9 percent
        - **(4)** The imperative to reform our healthcare system is driven by these economics
2. Development of the National Strategy for Quality Improvement
    - **a.** The current reform framework and changes in reimbursement policies have been pushed forward by a number researchers, private institutes, and government agencies building upon each other's work
        - **(1)** Most notable are the contributions from Berwick and colleagues from the Institute of Healthcare Improvement and the work of the Commonwealth Fund's Commission on High Performance Healthcare System
        - **(2)** Taken together, these two bodies of work redefined what should be the focus of care delivery—the *Triple Aims*, and detailed how a "high performance healthcare system" needs to operate and deliver care to achieve value
        - **(3)** The policy recommendations from both Berwick's and Shih's groups informed the guiding aims and priorities

adopted by the Department of Health and Human Services (HHS) in its National Strategy for Quality Improvement's framework for change

(4) This reform framework, first published by the Agency for Health and Quality Research (AHRQ) in March 2011 as the National Quality Strategy (NQS), is based on a translated version of IHI's *Triple Aims* of "better care, healthy people/healthy community, and affordable care" and six priorities that target making care safe, coordinated, based on evidence of clinical effectiveness, development of new care delivery and reimbursement models and community level focus for healthier living

b. Significantly, for post-acute care providers, one of the six national priorities targets care coordination with expectations for managed care transitions and communication across care settings

(1) Patients with chronic illness and disability are to have a current and shared care plan used by all providers, coordinated through primary care with extensions into community-based providers

(2) NQS includes that there is to be shared accountability of every member of the care team and organizational entity

(3) Access to patient information is to be readily available to every team member, including the patient; and measurements and reporting requirements are required from each integrated partner

(4) The implications of these care delivery mandates for the level of functionality, standards, and interoperability needed in our EHR systems across all sectors represents both opportunity and challenge for all of us

3. Affordable Care Act's operational arms

a. The two most influential health policy bodies created by mandate of the 2010 Affordable Care Act (ACA) are the CMS Innovation Center and the Patient Centered Outcomes Research Institute (PCORI)

(1) The CMS Innovation Center is focused on patient populations using Medicare, Medicaid or Children's Health Insurance Program (CHIP)

(2) Its charge is to test "*innovative payment and service delivery models to reduce program expenditures … while preserving or enhancing the quality of care*"

(3) The CMS Innovation Center is driving structural, care delivery initiatives, such as "Accountable Care Organizations" with the concepts of payment linked to "bundling" of services across a care continuum to manage a given population's health outcomes

(4) And complementing this payment system reform focus is PCORI's mandate to "*increase the quantity, quality, and timeliness of usable, trustworthy comparative research information; to accelerate the implementation and use of research evidence; and to exert influence on research funded by others to make it more patient-centered and useful*"

(5) PCORI funds comparative clinical effectiveness research on treatment methods, drugs, devices, and systems; and mechanisms for the rapid dissemination of these research findings for them to be put into practice rapidly

(6) Funding levels for the first three years of PCORI from 2010 to 2013 was $316 million for 192 studies, with the next three years funded at $1.5 billion

(7) These two important HHS health policy entities are driving rapid change within our healthcare practice structures linked as they are to new reimbursement incentives and penalties

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Introducing the Post-acute Providers

1. Overview

a. It can be confusing and difficult to those outside of the post-acute care sector to differentiate between the unique services each provides from those that overlap

(1) While not the sole providers of posthospital care, traditionally CMS includes home health agencies, skilled nursing facilities, inpatient rehabilitation facilities, and long-term care hospitals in this "post-acute care" category

(2) To assist in this overview, Table 25.1 lists each CMS recognized entity, the type of patient services provided, differences, patient eligibility requirement, payment structure, and episode period

(3) Medicare and Medicaid pay the significant portion of care expense for care delivered in the post-acute sector

(3) The Medicare benefit pays for skilled care, therapy, and other services delivered by inpatient rehabilitation facilities (IRF), skilled nursing facilities (SNF), long-term care providers (LTCH), home health agencies (HHA), and hospice

(4) Patients accessing the post-acute providers instead of ambulatory centers or clinics are those who are homebound, or have need of inpatient level of care, or have restricted mobility, or have six months or less to life

b. Just the sheer numbers of post-acute care providers and the volume of patients that each serves per year show that we cannot reach the goal of an integrated healthcare system at community levels without their inclusion in healthcare reform

(1) As listed at the bottom of Table 25.1, if nursing homes are included in post-acute care providers, there are over 44,500 organizations in this sector

(2) In 2012, approximately 3.5 million Medicare beneficiaries, or 10.6 percent of the 37.2 million Medicare beneficiaries, used home health services representing an average annual increase of 3.1 percent since 2002

(3) Similarly, hospice use between 2000 and 2012 has increased annually to an average of 8.7 percent, with just under 1.3 million Medicare beneficiaries served in 2012 as compared to 513,000 in 2000

(4) Skilled Nurses Facilities paid for under the Medicare benefit was almost $27.6 billion in fiscal year 2012 and served 1.7 million Medicare beneficiaries

  - **(5)** The 2012 Medicare spend for post-acute care was about 12 percent of total program expenditures
    - **i.** SNF at 6 percent
    - **ii.** Home health at 3.6 percent
    - **iii.** Hospice at 2.1 percent
    - **iv.** And IRFs and LTHCs at just about 1.5 percent
  - **(6)** The marked growth in the use of post-acute care over the last decade is due in part to the unprecedented growth in the number of Americans aged 65 or older
  - **(7)** In addition to Americans just living longer, the impact of the post-World War II baby boom is expanding the proportionate percentage of elderly in US demographics
  - **(8)** Starting January 1, 2011, each and every day about, 10,000 Americans have turned 65 years old and this trend is projected to continue through 2030, when about 72 million people will be over 65 (about 20 percent of Americans)
- **c.** As detailed in Table 25.l, every post-acute care setting carries eligibility requirements that must be met to be paid by CMS under Medicare
  - **(1)** Long-term care hospitals (LTCH) and inpatient rehabilitation facilities (IRFs) must meet the same conditions of participation that acute care hospitals are held for admissions and facilities criteria
  - **(2)** Unique to IRFs is the requirement that 60 percent of their patients must have 1 of 13 diagnoses specified by Medicare and this is referred to as the "60 percent rule"
  - **(3)** In addition to patients needing inpatient care, they are expected to improve with intensive rehabilitation therapy that goes on for three hours or more per day/five days a week
  - **(4)** LTCHs only program requirement for patients is that their average length of stay must be greater than 25 days
  - **(5)** Patients in need of skilled nursing facilities services commonly are those recovering from orthopedic surgeries, or other medical conditions requiring short-term skilled nursing care and rehabilitation services, such as stroke, neurological conditions, or acute pneumonia
  - **(6)** Rehabilitative therapies include physical therapy, occupational therapy, and is important for stroke and neurological patients' access to speech-language services that address safe eating, swallowing, and communication
  - **(7)** Most SNFs are part of a nursing home that treats patients who have exceeded the SNF 100-day limit, and, generally, are given less intensive, long-term care services than the skilled services required for Medicare coverage
- **d.** Home healthcare is the largest of all the post-acute care providers and continues to grow annually
  - **(1)** Eligibility is tied to homebound status, defined as requiring "considerable and taxing effort" to leave the home, and to the need for skilled nursing care or therapy to maintain or improve their health status and/or functional capacities
  - **(2)** Over the past decade, HHA are becoming less of a posthospital admission provider, and are taking an increasing percentage of their referrals from physician's offices, clinics, and community-based Assisted Living Facilities
  - **(3)** Between 2001 and 2009, home health episodes not preceded by an inpatient stay increased from 52 to 65 percent
  - **(4)** Hospice eligibility is linked to certification by an attending physician and a hospice medical director that the person is terminal and at the end stage of their disease trajectory with six or less months to live
  - **(5)** Hospice is also covered under the Medicare benefit, but until recently was seldom used as a discharge destination from a hospital stay

2. The role for post-acute care providers

- **a.** Increasingly, as Care Transitions demonstration projects mandated under the 2010 Affordable Care Act (ACA) have generated lessons learned in care coordination, other post-acute care providers, such as Hospices and Kidney Dialysis Centers, have started including themselves in planning

Teaching Tip

Provide the example, in Care Transition partnerships between home health agencies (HHA) and hospitals, these teams quickly learned how imperative it was to have a clinical profile tool with risk criteria that could differentiate and identify individuals at the "end of life" stage of a chronic disease from those with longer term trajectories. Without this specificity, these terminal patients were referred to providers with a rehabilitative or curative mandate post-discharge, such as, home health or a Skilled Nursing Facility (SNF).

  - **(1)** Because these patients are those projected as having a six months life expectancy, they are inherently not medically stable and the result is frequent Emergency Room visits and rehospitalizations
- **a.** This advancement in care transitions initiatives required care planning changes that depended on informatics and data analysis
  - **(1)** In these early initiatives, the partners had to have the ability to tract patients who had to be readmitted within 30 days from hospital discharge and report back to their partners
  - **(2)** This meant that the SNF's or HHA's clinical information system had to have the ability to capture patients' clinical profiles, protocol treatment outcomes, and clinical data with the ability to share with the hospital partner
  - **(3)** This level of functionality is largely missing in today's systems
  - **(4)** What most organizations report is that the functionality limitations needed to support care transitions and coordination are being compensated for by staff doing some portion of tracking and reporting manually

  - **(5)** The second major change that was informed by the data was for hospitals to actively include hospice as a posthospital destination and to take on the hard conversations with physicians, patient, and family to have that option available to the patient
  - **(6)** Once organizations made the leap to start looking for end-of-life criteria and defined hospice as an appropriate discharge placement (if patient and family agreed), progress was made
  - **(7)** Doing appropriate discharge planning for hospice eligible individuals rather than referring to home health has helped to mitigate rehospitalizations in this vulnerable population as well as improving the individuals' experience from their care
  - **(8)** It is in understanding the services that each post-acute care provider offers, that we will be able to align patients' post-discharge care plan with their needs and wishes
  - **(9)** Differentiating between services that offer curative, rehabilitative and maintaining, or preventing deterioration is essential in our efforts to achieve a healthcare system that embodies the means to deliver on the Triple Aim goals

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Clinical Information Systems in Post-acute Care

1. Overview
  - **a.** Just as Meaningful Use (MU) incentives are impacting acute and ambulatory care providers, they are also affecting the post-acute care providers even though they are not included as eligible providers for payment incentives
    - **(1)** Under MU, hospital organizations and physician offices are financially rewarded to adopt and use EHR functionality
    - **(2)** In just over a decade, EHR adoption has profoundly impacted how clinicians work, document, and use data in support of clinical decisions and care planning in these settings
    - **(3)** Accordingly, expectations for data exchange and empowering data analytics are expanding beyond the medical center and are being placed upon the post-acute care community
  - **b.** Through the ACA legislation, quality measure definition work of the National Quality Forum in conjunction with CMS' power of reimbursement sanctions, the last five years have seen a rapidly changing health policy landscape
    - **(1)** Quality measures in support of Triple Aim goals are required and linked to reimbursement
    - **(2)** The most disruptive measure to the status quo being readmission rates for conditions that call for post-discharge, care coordination to avoid risk of rehospitalization within 30 to 60 days
    - **(3)** As hospitals strive to address this risk to their revenues, they are beginning to reach out to Skilled Nursing Facilities, Home Health and Rehabilitation Facilities asking for data exchange, care planning and reporting that is catching the post-acute EHR industry unprepared for this level of functionality or sophistication
  - **c.** While the majority of post-acute organizations have information systems that include clinical documentation, these are designed largely to function as data captures for billing and CMS' mandatory minimum data bases sets
    - **(1)** Each post-acute provider has a mandatory minimum data set that must be submitted to CMS at regular intervals for each patient admission and discharge

Teaching Tip
See Table 25.1 as a condition for reimbursement by CMS.

    - **(2)** This regulatory requirement has driven the way systems have been built for the post-acute market over the past 30 years and is fundamental to understanding the current state
    - **(3)** Home health illustrates this evolution and why there is a lack of functional parity between the EHR systems serving the post-acute market as compared to those for acute and ambulatory care

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Teaching Tip
Students should review and discuss the Case Example.

Case Example: Evolution of Clinical Information Systems in Home Health

In 2000, CMS moved home health to prospective payment reimbursement that was linked to a new documentation tool—the Outcome and Assessment Information Set (OASIS) to be used at admission. Few legacy systems offered a clinical solution to capture even the routine visit notes in the home at this time. Patient records and clinical documentation were collected on paper and agencies' medical records were paper-based. In anticipation of the 2000 OASIS introduction, agencies started looking to their legacy billing and ADT (admission/discharge/transfer) system vendors to provide OASIS documentation capture. Vendors quickly responded by developing documentation systems that would allow for clinicians to capture the OASIS data and pass it directly into the back-end billing system, eliminating the need for office staff to reenter the OASIS documentation. Billing and ADT system vendors adopted a "bolt-on" approach to capture OASIS documentation. Consequently, the structure of the clinical documentation was based on a task concept that organized the patient record by visit note type in chronologic order, with each discipline having their separate documentation tasks. More than a decade later, the remnants of this developmental approach are evident in the system offerings in the marketplace today. Current state still has limited workflow support functionality, integrated patient record views, multidiscipline team workflow and patient care data views, clinical decision support, structured terminologies, and/or flexible quality reporting capabilities.

Unfortunately, the health information technology (HIT) software suppliers for the home health industry reflect the cottage industry nature of home health itself. There are a myriad of small vendors who supply their local markets with systems developed to cover the basic front office and billing functions with added OASIS capture functionality. These basic systems require minimal capital outlay and are affordable for the thousands of small sized agencies (over 10,000) that make up the bulk of the home health industry. However, that segment of the market with bigger buying power—the larger home health agencies and organizations, the Veterans Administration system and the hospital-based agencies have driven demand for and development of more comprehensive clinical systems with advanced functionality to integrate with their referral sources and the demands of MU functionality.

While the HIS vendors have matured their products to deliver point of care, clinical documentation, these systems still have a strong focus on driving the reimbursement process rather than supporting clinical workflow and decision support. Lack of structured clinical data still characterizes the industry today and has long challenged home health provider organizations' ability to provide quality and clinical outcome measures. The most mature products offer the ability to maximize reimbursement by managing the number of patient visits and identifying patients at risk of rehospitalization; and, clinician views are still task and note based, siloed by discipline. Most of the major vendors systems in the market today remain on their original 1980's technical platform architectures and programming languages. However, a very hopeful new development is the entry of new start-up vendors who have built their solutions as a Web-based platform, using cloud technology and i-Pad devices with the added advantage of leveraging off of Apple built applications. These 21st-century tools and architectures allow for rapid development, nimbleness, and options to plug into the side application market for Apple devices, with a very low cost of ownership. These new market developments offer a way forward for home health and the other post-acute providers and gives hope for significant progress and catch up to MU functionality levels over the next five years.

2. EHR adoption levels in home health
   a. From 2000 to 2013, there have been three national surveys conducted on the levels of EHR adoption in the home health industry
      (1) These are
         i. The 2000 National Home and Hospice Care Survey (NHHCS)
         ii. The 2006–2007 American Association of Homes and Services for the Aging
         iii. Fazzi Associates' 2013 survey of over 1000 HHA agencies
      (2) Tracking across these surveys shows a shift from only 32 percent of HHAs having clinical systems with the basic EHR functions in 2000 to 58 percent as reported in the 2013 survey
      (3) This means that a bit more than 40 percent of the agencies sampled in 2013 are still in paper mode for clinical documentation; and of those, only 42 percent reported that they would be looking to buy a system in the next 12 months
   b. Missing from these benchmarks, however, is the degree to which the specific functionality that is basic to EHR standards today is in the systems being used
      (1) This functionality includes
         i. Clinical decision support
         ii. Flexibility of views of patient care information
         iii. Point of care support for clinical documentation
         iv. Telemedicine
         v. Standardized, structured terminologies
         vi. And ability to send and receive patient information with other external providers
      (2) The authors of the 2007 survey study tried to answer this question by looking at the functionality used in the EMR systems
      (3) They reported the following
         i. Patient demographics—95 percent
         ii. Point of care clinical documentation—29 percent
         iii. Clinical notes—34 percent
         iv. Clinical decision support—34 percent
         v. Physician's ability to electronically sign orders on the plan of treatment order form—50 percent
      (4) Researchers found that sharing of health information data with other providers was almost negligible in 2007 stemming from
         i. The lack of enabling functionality
         ii. Such as the Consolidated Clinical Document Architecture (C-CDA) tool in the home health EHR systems at that time
      (5) While a 2013 survey did not address the question of functionality, the major vendors in the industry have moved to embrace the C-CDA tool since the 2007 survey

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Standards Needed for Care Coordination

1. Overview
   a. Standards for clinical information systems apply to the ways data are named, stored, and shared as well as to promote accuracy and to work more efficiently
      (1) Ultimately, standardized systems can improve patient safety and lower healthcare costs
      (2) When aspects of care coordination are standardized, it is easier to collect data and share data pertinent to care across multiple sites by various care providers
      (3) Care coordination has been a topic of interest for standard development and implementation organizations for many years, such as government agencies like
         i. CMS and HHS agencies such as the ONC Standards and Interoperability Framework
         ii. And by nonprofit agencies such as Health Level 7 (HL7) and Integrating the Healthcare Enterprise (IHE)

b. The Continuity Assessment Record and Evaluation (CARE) Tool was created by CMS as part of the Post-Acute Care Payment Reform Demonstration (PAC-PRD) authorized by the Deficit Reduction Act of 2005

- **(1)** The purpose of the CARE tool was to standardize patient assessment information from PAC settings to better understand differences of care provided to similar patients at different settings and guide payment polices
- **(2)** The CARE tool uses Web-based technology to develop an interoperable data reporting systems for the Medicare program
- **(3)** The Web-based technology allows for future changes in the data sets to incorporate advances in evidence-based care
- **(4)** The CARE tool is designed to minimize the provider burden and only includes items related to severity, payment or monitoring the quality of care
- **(5)** The CARE tool was developed based on previous tools in use such at OASIS, MDS, and IRF-PAI in 2006
- **(6)** The tool was tested in a two-phased demonstration project during 2008–2010
- **(7)** Its initial use was required by CMS for LTCH in the fall of 2012
- **(8)** Additional pieces have been and will continue to be required as the CMS continues to roll out additional quality measures

c. Another major focus of SDOs has been defining the shared care plan

- **(1)** The care plan has great potential for facilitating coordination of care across settings and between multiple disciplines
- **(2)** It is one centralized location where all care team members can see a patient's individualized health goals
- **(3)** There is potential for the care plan to be exchanged between settings allowing for continuity of care provided
- **(4)** Standardization of care plan elements is key to facilitating this exchange
- **(5)** Many SDOs are addressing the needs of care plan definition and organization
- **(6)** Care plan elements have been the topic of standardization efforts for several years at HL7
- **(7)** The HL7 Patient Care, Structured Documents, and the Services-Oriented Architecture Working Groups have all sponsored projects related to the care plan
- **(8)** Projects have ranged from
  - **i.** Describing a conceptual model for the care plan and determining standard messages
  - **ii.** To communicating key care plan elements to defining a service-oriented architecture
- **(9)** In addition, the IHE's Patient Care Coordination (PCC) workgroup and the Office of the National Coordinator (ONC) Standards & Interoperability Framework (S&I Framework) have also done considerable work to define a standard care plan that can serve multiple care transition use cases, and population management of individuals with chronic diseases

d. The Consolidated Clinical Document Architecture (C-CDA) is the result of a harmonization project addressing overlapping efforts of HL7, IHE, Health Information Technology Standards Panel (HITSP), and the Health Story Project

- **(1)** CMS adopted the C-CDA as a tool that gave provider organizations a means to accomplish patient information exchange, and for EHR vendors to embed in their products to meet ONC's certification requirements
- **(2)** CMS' Medicare and Medicaid EHR Incentive Program (commonly referred to as MU) rewards eligible providers for EHR adoption through incentive payments
- **(3)** Acute and ambulatory care providers can only qualify for CMS incentive payments by using EHR systems that have met ONC's EHR certification criteria
- **(4)** In this instance, the functionality for the exchange of patient care summaries and other patient information needed for care coordination
- **(5)** Initially available for the exchange of clinical summaries, the C-CDA has also been reviewed and revised to support its use for the exchange of care plans

e. The 2014 Edition Certification Program for Health Information Technology specifically calls for the use of the HL7 C-CDA to be used for capturing and exchanging patient summary information

- **(1)** Implementation guides (IGs) are tools created by the HL7 community to provide guidance on how the standards developed by the organization are to be implemented
- **(2)** In some cases, however, the IGs are insufficient for implementers and questions to the use of the standard remain
- **(3)** In some cases, if these questions are answered by each site implementing their unique interpretation of the standard, these independent solutions result in the inability to exchange information even when the standard was followed
- **(4)** The S&I Framework's Transition of Care Initiative took this challenge and produced a companion guide to supplement the Consolidated Clinical Document Architecture (C-CDA) Implementation Guide (C-CDA IG)
- **(5)** This deliverable is useful for those implementing C-CDA by providing samples of clinically relevant documents and suggested testing procedures

f. Some of these SDOs have completed their standards development process and others are still being publically reviewed and revised

- **(1)** Completed and published HL7 Standards can be found at http://www.hl7.org/implement/standards/index.cfm?ref=nav
- **(2)** HL7 standards still under development and reviewing are best found by contacting the working groups through their respective cochairs (http://www.hl7.org/about/hl7cochairs.cfm)

- **(3)** IHE has the unique role of providing more specific information related to integrating and implementing standards created by the SDOs
- **(4)** There are multiple domains, clinical and other nonclinical healthcare domains, represented in IHE
- **(5)** PPC domain is specifically concerned with identifying, clarifying, and testing standards related to coordinating care across settings and disciplines
- **(6)** The framework maintained by IHE-PCC provides technical specifications with clinical use cases and examples specifically describing the implementation of standards to facilitate care coordination
- **(7)** IHE tests each of the technical specifications proposed for inclusion into the framework by inviting vendors to participate in an annual "Connectathon" event
- **(8)** At this event, vendors implement the proposed specification as either a "creator" or a "receiver" of the content included in the specification and demonstrate a successful exchange of content with other participating vendors
- **(9)** The IHE-PCC committee has created several specifications related to care coordination including
    - **i.** Care Management (CM)
    - **ii.** Cross-enterprise Basic eReferral Workflow Definition (XBeR-WD)
    - **iii.** Patient Care Plan (PtCP)
    - **iv.** Patient Plan of Care (PPOC)
- **(10)** These and other IHE-PCC supplements for trial implementation can be found at http://www.ihe.net/Technical_Frameworks/#pcc

g. The ONC launched the S&I Framework in January of 2011 to engage community involvement on interoperability challenges critical to meeting MU objectives

- **(1)** The Transitions of Care (ToC) Initiative was one of the first teams to be organized
- **(2)** This workgroup focused primarily on building consensus toward the exchange of clinical summaries
- **(3)** The ToC also quickly expanded its focus to address the usefulness and need for the exchange of the care plan for the overall success of care coordination
- **(4)** This care plan focus led to the formation of the Longitudinal Care Coordination (LCC) Initiative which has been dedicated to identifying and validating a standards-based framework for care management of chronic disease populations across multiple settings and disciplines
- **(5)** The LCC Initiative consists of several related sub-workgroups
- **(6)** These workgroups have addressed or are in the midst of addressing and refining several aspects of patient information exchange in the longitudinal care space
- **(7)** These areas of focus include
    - **i.** Functional and health status assessments
    - **ii.** Patient and care team goals and desired outcomes
    - **iii.** And the interoperable care plan
- **(8)** The deliverables of these community led initiatives include
    - **i.** Identifying use cases and the key data elements and functional requirements supported by key assessment areas and a longitudinal care plan
    - **ii.** And addressing key longitudinal care planning gaps in existing and evolving standard
- **(9)** The LCC provides guidance to community outreach pilot programs to implement evolving care coordination tools in real-world situations to identify policies required for operational systems

h. For all this standards development work and despite efforts on the parts of many committed individuals and organization to collaborate and harmonize across the different standards organizations, there is not yet one data set or set of definitions identified for the requirements of patient information exchange for care coordination or for the care plan

- **(1)** Effort has been made in many instances toward consensus on items like LOINC (Logical Observation Identifiers Names and Codes®) but different templates, timing of development, review processes, engaged team members, and international involvement often affect the end result
- **(2)** Future work in the area is needed, however, to harmonize data sets and definitions identified for care coordination to minimize confusion and maximize information exchange for optimal care coordination
- **(3)** The road to complete interoperability is not yet complete
- **(4)** Progress has been made through standardized tools such as the CARE tool and the C-CDA, but it is just a beginning
- **(5)** IHE has demonstrated interoperable success through events such as the Connectathon
- **(6)** Day-to-day use of interoperable Care Plans between acute- and post-acute care areas is not yet started
- **(7)** Complete implementation and use of standardized interoperable care plans is challenged by the long history of different definitions and use of care plans over many decades
- **(8)** There are as many definitions and clinical processes for care planning as there are unique sites of care and individual care providers
- **(9)** Physicians, bedside nurses, care managers, physical therapists, nutritionists, etc. all use care plans consisting of data elements and workflow specific to their own care domains
- **(10)** Care plans have served more as a tool for the specific discipline to meet their purposes or regulations than ever applied as a patient-centered tool crossing care setting or discipline boundaries
- **(11)** Many standards development and implementation organizations have focused their efforts on specifying the data elements and the definitions to be in a care plan
- **(12)** Implementation organizations have worked to demonstrate the ability to exchange care plan content across disparate clinical information systems

        (13) In some cases (HL7 and IHE), the SDOs clearly state that their work is not to determine governance or clinical process for care planning but to define the content and the tools allowing them to be used for care coordination regardless of governance or clinical process

    i. The impact to vendors of the standards development related to care coordination varies based on their current tools in place

        (1) Meeting requirements for CMS certification for use in meeting MU incentive payments is the greatest focus for most

        (2) For Stage 2 MU this means that the exchange of certain data elements related to care coordination, such as problems, goals, and instructions

        (3) The standards communities and vendors try to anticipate upcoming regulations and clinical needs for healthcare information exchange

        (4) Regardless, there is often some scrambling within and between the organizations and vendor communities between the times a regulation is announced and the initial implementation date

    j. Nursing has been represented in all phases and environments of standards development for care coordination

        (1) Each of the SDOs reviewed here embraces wide engagement from all disciplines

        (2) The SDOs encourage clinicians and clinical informaticists to contribute in leadership roles, and also as contributors, reviewers, testers, and/or implementers

        (3) Nurses engaged in these development projects represent the full spectrum of nursing including

            i. Acute care

            ii. Pediatric care

            iii. Chronic care

            iv. Care management

            v. Post-acute care

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

DISCUSSION

- US healthcare spending puts an unsustainable burden on taxpayers who fund Medicare and Medicaid, employers who fund healthcare insurance as an employment benefit, and individuals doing self-pay
- If the Healthcare Exchanges mandated under the 2010 Patient Protection and Affordable Care Act become an operational reality, then the United States will lose the dubious distinction of being the only industrialized nation that does not provide universal health insurance to its population
- Regardless of how the United States pays for its healthcare, reforming how care is delivered and reimbursed to achieve value for dollar spent is now well underway
- System reform holds opportunity for post-acute care to be tightly integrated partners at community levels for the first time
- Care coordination is multidimensional and essential to preventing adverse events, ensuring efficiency, and making care patient centered
- Patients in greatest need of care coordination include those with multiple chronic medical conditions, concurrent care from several health professionals, many medications, extensive diagnostic workups, or transitions from one care setting to another
- Effective care coordination requires well-defined multidisciplinary teamwork based on the principle that all who interact with a patient must work together to ensure the delivery of safe, high-quality care
- This integration calls for fairly sophisticated levels of EHR system capabilities, and this may present challenges for most organization given the current state of information systems in the post-acute market
- The US healthcare system is in the process of dramatic and rapid change
- Health policy and reimbursement reform is being driven on multiple legislative and regulatory fronts
- Areas most impactful to the post-acute care sector are those under the National Quality Strategy's priority for care coordination and the management of care transitions
- These aims and priorities are currently defined through readmission outcome metrics that are linked to significant CMS reimbursement penalties
- To date these reimbursement penalties have applied to hospitals for just three conditions (acute myocardial infarction, heart failure, and pneumonia)
- But CMS will be adding additional readmission measures to include
    - Hospital-Wide All Cause Unplanned Readmission Measure (HWR measure) to apply to LTHCs, IRFs and all acute and critical access hospitals
    - Hip/knee arthroplasty, and chronic obstructive pulmonary disease for FY2015
    - Strokes for FY 2016
    - And MedPAC proposed readmission penalties for Home Health and SNF
- Just as these forces for change are making operational expertise within one sector insufficient, clinicians and informaticists alike must be informed of the full care continuum
- This knowledge is fundamental to our ability to do effective and appropriate care planning with coordination that includes the patient and family in decision making today and going forward
- For those that design, build, test, implement and support clinical systems use in organizations, these broader understandings of integrated and coordinated care are essential
- Also, to deliver care and information systems that support care that is coordinated, inclusive of patient, cost effective and achieves highest outcomes, we have to be able to work as a team that goes where the patient and family go—out into community and mostly home

- It could be easily argued that the majority of healthcare that makes a difference in health levels happens where the patient lives
- Yet in the United States, we have tended to think of care delivery as a place a patient goes to, a hospital, Emergency Room, Doctor's office or Clinic
- Current economic imperatives, changing demographics of our aging population, and healthcare policy are all driving rapid innovation in our healthcare delivery methods that call for an expansion out into community and home
- And home may be in Assisted Living Facilities, Senior Living residences, Group Homes, Memory Care Facilities or Nursing Homes
- Informatics has a major role to play in reaching the NQS goals of a healthcare system that delivers value for money spent and a healthier population
- Detailed information technology requirements are needed for functionality that must be in place in a cross continuum to support care coordination, communication and access data collection, measurements and reporting—all infrastructure capabilities that are missing in some degree in our EHR systems today across care settings
- Nursing and nursing informatics are optimally positioned to be leaders in the teams that design, build, and implement these new health and IT systems that enable care coordination

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Define the post-acute care delivery continuum and their contribution to the *Triple Aims* of increased quality at reduced costs, improved patient experience and improved population health
- Identify the current state of standards needed for care coordination across post-acute care delivery
- Describe how healthcare policy and regulations require participation of all care delivery sites including post-acute care to accomplish full care coordination
- Explain the current functionality and adoption of EHR tools available to and used by post-acute care providers

Teaching Tip

Ask the students to define the keywords

- Care delivery
- Post-acute care
- Care planning
- Care plan
- Care coordination
- Care transition
- Quality improvement
- National quality strategy
- Community
- Inpatient-rehabilitation facilities (IRF)
- Skilled nursing facilities (SNF)
- Long-term care providers (LTCH)
- Home health agencies (HHA)
- Hospice
- Standards development organizations (SDOs)

CHAPTER REVIEW QUESTIONS

Question 25.1: In what aspects of care is care coordination essential?

a. In identifying outliers of care
b. In preventing adverse events, ensuring efficiency, and making care patient centered
c. In supporting the patients with acute illness
d. In preventing toxicities of drugs, insuring efficacy, and making care continuous

Question 25.2: Under what conditions do patients require the greatest need for care coordination in the continuum?

a. Those with Acute needs like sinusitis, allergies, and headache
b. Those with disabilities
c. Those with chronic conditions
d. Those without healthcare insurance

Question 25.3: Through what three conditions are the National Quality Strategy's current priorities defined?

a. Asthma, end-stage renal disease, and stroke
b. Acute myocardial infarction, heart failure, and pneumonia
c. COPD, heart failure, and stroke
d. Cancer, heart failure, and pneumonia

Question 25.4: Into what other healthcare conditions is the National Quality Strategy expanding in the future?

a. Hip/knee arthroplasty, and chronic obstructive pulmonary disease for FY 2015; and strokes for FY 2016
b. End-stage renal disease for 2015 and stroke for 2016
c. COPD, cancer and heart failure in 2015
d. Acute heart failure, pneumonia, and strokes in 2015

Question 25.5: What are the IT principles that impact on the continuum of care?

a. Ability to interface with labs and images
b. Integrated and coordinated care architectures built into the systems are essential
c. Architectures that are built upon same COTS products
d. Integrated care built into the medication profiles

Question 25.6: What is an important standard being developed to support care coordination and the continuum of care?

- **a.** SNOMED alone
- **b.** Only laboratory standards such as LOINC
- **c.** Medication standards will solve the integration problem
- **d.** The Integration Framework (S&I Framework)

Question 25.7: What are the six national priorities of the Triple Aim by Berwick?

- **a.** Making care safe
- **b.** Making care coordinated, and based on evidence of clinical effectiveness
- **c.** Development of new care delivery and reimbursement models and community level focus for healthier living
- **d.** All of the above

Question 25.8: True or False. According to the National Quality Strategy, patients with chronic illness and disability are to have a current and shared care plan used by all providers, coordinated through primary care with extensions into community-based providers.

Question 25.9: What are the two most influential health policy bodies created by mandate of the 2010 Affordable Care Act (ACA)?

- **a.** AHRQ and the Evidence Center
- **b.** The CMS Innovation Center and the Patient Centered Outcomes Research Institute (PCORI)
- **c.** ONC and the FDA
- **d.** ONC and the CMS

Question 25.10: What is a funding agency to fund comparative clinical effectiveness research on treatment methods, drugs, devices, and systems; and mechanisms for the rapid dissemination of these research findings for them to be put into practice rapidly?

- **a.** AHRQ
- **b.** CMS
- **c.** NIH Institute for Nursing Research
- **d.** PCORI

ANSWERS AND EXPLANATIONS

Question 25.1: (b) Care coordination is multidimensional and essential to preventing adverse events, ensuring efficiency, and making care patient centered.

Question 25.2: (c) Patients in greatest need of care coordination include those with multiple chronic medical conditions, concurrent care from several health professionals, many medications, extensive diagnostic workups, or transitions from one care setting to another.

Question 25.3: (b) To date these reimbursement penalties have applied to hospitals for just three conditions (acute myocardial infarction, heart failure, and pneumonia).

Question 25.4: (a) Hip/knee arthroplasty, and chronic obstructive pulmonary disease for FY 2015; and strokes for FY 2016.

Question 25.5: (b) Integrated and coordinated care architectures are essential.

Question 25.6: (d) The work being done by the Office of the National Coordinator's (ONC) Standards and Integration Framework (S&I Framework).

Question 25.7: (d) All of the above. Six priorities that target making care safe, coordinated, based on evidence of clinical effectiveness, development of new care delivery and reimbursement models and community level focus for healthier living are priorities of the Triple Aim.

Question 25.8: True. According to the National Quality Strategy, patients with chronic illness and disability are to have a current and shared care plan used by all providers, coordinated through primary care with extensions into community-based providers.

Question 25.9: (b) The two most influential health policy bodies created by mandate of the 2010 Affordable Care Act (ACA) are the CMS Innovation Center (14) and the Patient Centered Outcomes Research Institute (PCORI).

Question 25.10: (d) PCORI funds comparative clinical effectiveness research on treatment methods, drugs, devices, and systems; and mechanisms for the rapid dissemination of these research findings for them to be put into practice rapidly.

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Foundation of a Nursing Plan of Care Standard

• OBJECTIVES

1. Describe the structure for plan of care (PoC) in health information system.
2. Describe the complexity of nursing care and knowledge.
3. Discuss the nursing PoC standard for use in coded nursing care plans.
4. Describe an educational framework for health information standards' initiatives.
5. Discuss standard for information retrieval of nursing PoC information.
6. Clarifies nursing process standard to which nurses are held accountable.

• KEY WORDS

Nursing plan of care (PoC)
Clinical Care Classification (CCC)
System
Meaningful use
Nursing process
Information standard
Integrating the Healthcare Enterprise (IHE)
American National Standards Institute (ANSI)
Healthcare Informatics Standards Panel (HITSP)

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What are some federal initiatives that are influencing healthcare and health information technology? Can you describe the nursing process? Can you describe a plan of care? Can you name a nursing terminology?

For a WIIFM statement, say to the class, "The purpose of this chapter is to provide nursing initiatives focusing on the nursing plan of care (PoC) standard to strengthen the use of nursing standards in inpatient hospitals' electronic health record (EHR) systems. The chapter will (1) examine the nursing PoC within the current federal 'Meaningful Use' regulations, (2) identify organizations involved in the selection of information management standards for the healthcare industry, including nursing, and (3) provide an example of a standard-based nursing PoC following the nursing process that is easily implemented in any EHR system. The chapter will also describe the use of the Clinical Care Classification (CCC) System as an example of a nursing terminology—a data integrator and standard for the exchange of nursing documentation among and across health information technology systems." As a nurse, it is important to understand nursing initiatives, the nursing process, and nursing terminologies such as the CCC System.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Background

1. Overview
    - **a.** A Nursing Special Interest Group (SIG) was initiated in 2006 within the Integrating the Healthcare Enterprise (IHE), an International Standard Development Organization, to reflect the importance of communication integrity and continuum of care during patient/client transfers
        - **(1)** The Institute of Medicine (IOM) has identified that the highest risk of errors affecting patients occur at the point of care transfer
        - **(2)** The group represented
            - **i.** Acute
            - **ii.** Home health
            - **iii.** Psychiatric
            - **iv.** Long-term care entities
        - **(3)** Use Cases were written
        - **(4)** Agreements included the need for evidence-based documentation and started with initial assessment details based on regulatory body requirements
        - **(5)** In October 2007, a proposal came to the Planning and Technical Committee of the Patient Care Coordination Domain, requesting the approval of an IHE Nursing Subcommittee and the IHE Nursing Subcommittee came into existence mid-2008
        - **(6)** The Nursing Subcommittee began moving forward with a profile to demonstrate use of nursing process to illustrate documentation of plan of care elements illustrating patient progress along the health—illness continuum
        - **(7)** This focus was demonstrated in 2010 when a nursing plan of care (PoC) profile standard was successfully balloted ASA patient plan of care (PPOC)
        - **(8)** The PPOC did not specify nursing, it has been interpreted by IHE members as referring to all health professionals providing care to a patient even though the PPOC used a nursing terminology (CCC System) and followed the nursing process
    - **b.** Medical diagnoses cannot be expected to explain the nursing care of patients nor function as the primary framework for documenting patient care and professional nursing data for communities, families, and individuals
        - **(1)** The goal of nursing care is to improve health
        - **(2)** The nursing PoC standard describes the complexity of nursing care
        - **(3)** The nursing PoC is a reference standard for the implementation of structured nursing data in electronic healthcare information systems
        - **(4)** The nursing PoC standard was developed by informatics nurse specialists to encourage Standard Development Organization interest in the information exchanges of the largest group of healthcare professionals—nurses!
    - **c.** Nursing standards reflect the information insights of Florence Nightingale who through her groundbreaking work in informatics founded nursing as a theory-based, scientific profession with an independent body of knowledge and wisdom
        - **(1)** Nightingale focused on quality indicators of patient care and the measures of care which lead to the development of nursing standards as the framework for care accountability in nursing
        - **(2)** These standards
            - **i.** Were based on empirical evidence and experience
            - **ii.** Were used by Nightingale
            - **iii.** To develop powerful analytical displays of data to support performance-based nursing—early evidence-based practice and the current foundation of nursing care and practice
    - **d.** In the early 1900s, nursing standards were based primarily on the educational levels of the nurses and the standards of performance were embodied in the early state nursing licensing statutes
        - **(1)** The American Nurses Association (ANA)
            - **i.** Recognized the need for evidence to measure the relationship of clinical documentation on patient care
            - **ii.** And provided the authority and support for standardizing nursing practice
    - **e.** In 1970, the ANA recommended the "nursing process" become the professional standard of nursing practice
    - **f.** As computer technology advanced so did nursing's awareness of the need for structured documentation of nursing practice
    - **g.** In 1992, ANA Database Steering Committee "recognized" the first four nursing terminologies
        - **(1)** Clinical Care Classification (CCC) System (originally Home Health Care Classification [HHCC])
        - **(2)** North American Nursing Association (NANDA)
        - **(3)** Nursing Intervention Classifications (NIC)
        - **(4)** OMAHA System
        - **(5)** As well as approving a new nursing specialty, "Nursing Informatics"
    - **h.** The ANA subsequently developed the *Scope and Standards of Nursing Informatics Practice* which endorsed the nursing process' six standards (phases) for Nursing Informatics Practice
    - **i.** The ANA also recognized
        - **(1)** The need for quantitative evidence to measure the relationship of clinical documentation to the impact on patient care
        - **(2)** And a scientific foundation for evidenced-based practice
    - **j.** In 2008, O'Kane et al. noted that the fundamental building block of any high-performance health system is reliable information about the effectiveness of care
        - **(1)** Yet, EHR systems are not designed for documenting a dynamic plan of care following the nursing process at the point-of-care

Teaching Tip

Provide the example, in many health information record systems the information flow for nursing is disjointed; largely focusing on tasks rather than the individual care needs of the patient. The effect on the patient care in the acute setting is that the documentation of the admission nursing assessment does not inform nor connect to patient treatment orders. Currently, electronic nursing PoC are generally "textbook" protocols not uniquely designed for a specific patient and display the nurses' workflow or conversely nursing PoC are written as free-text, paper-based, nursing notes without any framework or structure.

- **k.** The purpose of this chapter is to provide nursing initiatives focusing on the nursing PoC standard to strengthen the use of nursing standards in inpatient hospitals' EHR systems
- **l.** The chapter will
  - **(1)** Examine the nursing PoC within the current federal "Meaningful Use" regulations
  - **(2)** Identify organizations involved in the selection of information management standards for the healthcare industry including nursing
  - **(3)** Provide an example of a standard-based nursing PoC following the nursing process that is easily implemented in any EHR system
- **m.** The chapter will also describe the use of the CCC System as an example of a nursing terminology—a data integrator and standard for the exchange of nursing documentation among and across health information technology systems

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Introduction

1. Federal initiatives
   - **a.** The federal government began to focus on computer-based healthcare technology with the IOM report on *The computer-based patient record*
     - **(1)** The IOM asserted that the computerization of the patient records could improve the quality and safety of patient care
     - **(2)** This landmark document, as well as the *To Err in Human* and *Preventing Medication Errors*, reports affirmed that electronic healthcare record systems could reduce the number of medication errors and death in hospitals and prevent medication errors
     - **(3)** These reports and numerous other initiatives addressing this issue led to Executive Order No. 13335, "*Incentive for the Use of Health Information Technology and Establishing the Position of the National Health Information Technology Coordinator*" that established the Office of the National Coordinator (ONC)
     - **(4)** The ONC was legislatively mandated under the Health Information Technology for Economic and Clinical Health Act (HITECH) of 2009, part of the American Recovery and Reinvestment Act (ARRA) of 2009; a $789 billion dollar economic stimulus package which was implemented during the global economic decline
     - **(5)** The HITECH Act allocated $19 billion to hospitals and physicians who demonstrate the "meaningful use" of electronic medical records
   - **b.** In 2005, the ONC mandated the American National Standards Institute (ANSI) establish a strategy for reviewing and recommending healthcare technology standards which resulted in the dissolution of the ANSI Healthcare Informatics Standards Board (HISB) and the formation of the Healthcare Information Technology Standards Panel (HITSP)
     - **(1)** The HITSP mission was to identify the healthcare standards that would be required for the electronic documentation of patient care and interoperable with other systems
     - **(2)** The strategy used by HITSP, a public consensus panel composed of industry stakeholders, was to review and analyze specific "Use Cases" and identify standard terminologies based on an objective and well-defined business process approach and criteria
     - **(3)** The selected HITSP standards were produced through agreement by a group of experts, publicly vetted to ensure "fit for intended" purpose, availability of accessible format, and an ongoing review and revision process
   - **c.** In analyzing the "Use Cases" for Biosurveillance, nurses noted most terminology standards in hospitals were used for the reimbursement of medical services and terminology used for the documentation of the patient care processes performed by the nurses was overlooked and a missing "gap" from the national dialogue
     - **(1)** As a result, the HITSP Biosurveillance Committee analyzed, vetted, and selected the CCC System as the first national nursing terminology that was interoperable for the documentation of patient care
     - **(2)** And upon recommendation from the Office of the National Coordinator for Health Information Technology (ONCHIT) and by HITSP, the CCC System was adopted as an interoperable national nursing standard by the Secretary of Health and Human Services
   - **d.** In total, 58 terminology and interoperability standards were selected by HITSP for the computer processing of patient care for the Secretary of the United States of the DHHS
     - **(1)** Subsequently, the number was reduced to 28 standards for the implementation of the HITECH ACT of 2009 "Meaningful Use" (MU) legislative regulations
     - **(2)** The standards selected were primarily selected for the reimbursable services of inpatient departments such as laboratory, pharmacy, and radiology
     - **(3)** Nursing documentation and services were again excluded because nursing is not yet a reimbursable patient care service
     - **(4)** Nursing labor continues to be invisible in the billable rate of the inpatient room rate or obscured in the administrative (G&A) costs of outpatient and other facility settings

2. Development of a nursing plan of care
    - **a.** Once HITSP selected a nursing standard for the documentation of patient care, the informatics nurses engaged in HITSP, solicited the Integrating the Healthcare Enterprise to use the HITSP selected nursing terminology and develop a methodology for the documentation of patient care
        - **(1)** As a result, the nursing PoC, under the name of the *Coded Nursing Documentation Plan of Care* was proposed and accepted by IHE as a new work item proposal [NWIP]
        - **(2)** The NWIP underwent additional developed by nursing and technical experts and using the consensus process was publically vetted under the name of the Patient Plan of Care (PPOC) recognizing the patient-centric focus of healthcare
        - **(3)** The PPOC is an IHE profile describing the data concepts needed by nurses for documentation in the EHR
        - **(4)** The Patient Plan of Care (PPOC) explicitly formalized the data requirements of nurses for the efficient and timely capture of care events at or near the bedside acknowledging the patient-centric healthcare environment
        - **(5)** The intent was to interpret for non-clinicians usual and customary nursing workflows, data and documentation concepts, and the nursing process structure used in documenting nursing events at the point of care
        - **(6)** The PPoC provided the context for nursing data using common scenarios following the ANA Nursing Process standard (six phases) represented by the information model and terminology (vocabulary) of the CCC System
    - **b.** The CCC System was used repeatedly as an exemplar of structured, coded, nursing terminology
        - **(1)** The use of the CCC System for the IHE profile standard was an extension of the interoperability conformance recognition of the CCC by Health Level Seven (HL7) interoperability for electronic transmission and the integration of the CCC System in the Unified Medical Language System (UMLS) for all clinical settings
        - **(2)** The CCC, specifically designed for computer-based systems, conforms to the Cimino criteria for standardized terminology
    - **c.** The nursing PoC identified a missing and essential professional component for the electronic documentation of nursing practice
        - **(1)** The nursing PoC standard used the CCC System to name, describe, and code the nursing "*essence of care*" which refers to "documentation of the primary reason including the essential nursing care needs" for providing patient care for a specific condition
        - **(2)** Thus, the PoC was evaluated and accepted as a Standard Development Organization (SDO) work program initiative
        - **(3)** Several of the Nursing Informatics (NI) Committees and Nursing Special Interest Groups supported and promoted the nursing PoC integration into the Centers for Medicare and Medicaid Services (CMS) MU Regulations
3. Meaningful use
    - **a.** Currently in the Meaningful Use (MU) requirements is the term Eligible Professionals (EPs) and defined by CMS as "responsible for the diagnosis and treatment of patients prescribing medications, laboratory tests, radiology procedures, other care modalities, activities and services"
    - **b.** The definition in the regulation encompasses traditional nursing practice responsibilities
        - **(1)** Provide individualized patient care
        - **(2)** Coordinate care with other providers
        - **(3)** Provide caring practices
        - **(4)** Use the nursing process (integration of singular actions of assessment, diagnosis, and identification of outcomes, planning, implementation and evaluation) to provide and document patient care
        - **(5)** And provide quality healthcare and achieve optimal outcomes
    - **c.** Professional nurses are also responsible for the implementation of medical provider orders and the collaboration with allied health professionals
        - **(1)** Physical therapists
        - **(2)** Occupational therapists
        - **(3)** Respiratory therapists
        - **(4)** Speech therapists
        - **(5)** And others
4. Meaningful Use Stages 1 and 2
    - **a.** Initially, one of the four proposed denominators in the Stage 1 MU objectives omitted and excluded the eligible providers of patient care and/or the caring process
        - **(1)** As stated, above, the MU focus was on provider orders for reimbursable special services in Computerized Provider Order Entry (CPOE) systems

Teaching Tip

Use the following example: "Number of orders for medications, laboratory tests and radiology" were entered in the EHR system and if the application was implemented successfully, the hospital/facility received federal funds from the ONC technology program. The process continued in MU Stage 2 and focused on quality indicators.

5. How a nursing plan of care could impact meaningful use
    - **a.** In the public comment periods for MU Stages 1 and 2, written recommendations were made to CMS for endorsement of the IHE nursing PoC standard to achieve interoperable healthcare data for quality indicators
        - **(1)** These recommendations cited the implementation of at PoC standard to advance the MU impact on quality, safety, and the outcomes of patient care needed to evaluate the episode of illness
        - **(2)** By adding a nursing PoC to the MU "Number of Orders" denomination, the denominator could standardize the various terms used to describe the care process: care plan, plan of care, treatment plan, etc.
        - **(3)** Second, the nursing PoC using the Nursing Process framework provides a complete minimum requirements

for a care plan field: "problem" (focus of the care plan) with (1) Assessment, and (2) Diagnosis, (3) Goal (target outcome)/Expected Outcome, (4) Planning, (5) Implementation ("instructions" for Interventions and Actions), and (6) Expected Outcome (target or measure/outcomes achieved)

    (4) Third, with the nursing PoC included in the MU patient care reporting, the nursing PoC could generate a status report of the status of the patient at any point in time, updated and revised based on specific clinical requirements, and addressed in the clinical decision support systems

  b. For CMU and MU, the nursing PoC offered a readily available standard to summarize the quality care as part of each Clinical Quality Measure's Description (based on six phases) for the transition of care (ToC) along the continuum of care

  c. The recommendation was deferred to MU Stage 3

6. Meaningful Use Stage 3

  a. Meaningful Use Stage 3 is poised to identify the requirements for care coordination and sharing of information across multiple provider groups—from long-term care and post-acute care to behavioral health and other allied services

    (1) There is growing recognition of the need for and the benefits of fully interoperable health information technology system's capabilities across provider groups and of the importance of the information or data needs of the medically complex and/or functionally impaired individuals within provider groups service

    (2) Effective, collaborative partnerships among service providers and individuals are necessary to ensure that individuals have the ability to participate in planning their care and that their wants, needs, and preferences are respected in healthcare decision making

  b. The identification and harmonization of standards for the longitudinal coordination of care will improve efficiencies and promote collaboration by

  - Improving provider's workflow by enabling secure, single-point data entry for the Transfer of Care (ToC) and Care Plan exchange including a nursing PoC
  - Eliminating the large amount of time wasted in phone communication and the frustrations and dissatisfaction of the receiving provider in not always obtaining care transition and care planning information in a timely manner
  - Reducing paper and fax transmissions, and corresponding labor intensive, manual processes during a ToC or Care Plan exchange including a nursing PoC
  - Supporting the timely transition of relevant clinical information at the start of home healthcare and as the patient's condition changes
  - Enabling sending and receiving provider groups to initiate and/or recommend changes to patient interventions more promptly

  c. In 1991, Carpentio cited the benefits of care planning

    (1) Ability to provide written directions rather than verbal communication to reinforce patient safety in hand-offs of care

    (2) Ensures continuity of care

    (3) Prioritizes problems

    (4) Provides a means to review and evaluate care

    (5) And demonstrates the complex role of professional nurses in the health settings

  d. Almost 25 years later, legislation is bringing nurses closer to standard-based care planning

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Nursing Plan of Care Framework and Nursing Process

1. Overview

  a. The theoretical framework for a fully operational the nursing PoC is the Nursing Process "the common thread uniting different types of nurses who work in various areas of nursing practice is the nursing process—the essential core of practice for the registered nurse to deliver holistic, patient-focused care"

    (1) The Nursing Process encompasses all significant nursing actions—the process forms the foundation of the nurse's professional practice and decision making

  b. The nurse is required to apply nursing knowledge systematically and logically to interpret, analyze and use data to determine the appropriate plan of care based on knowledge of the physical, biological and behavioral sciences

    (1) As part of academic preparation, nurses have biochemistry, biophysics, microbiology, anatomy, physiology, psychology, and sociology courses

    (2) This basic knowledge of the sciences enables nurses to recognize patient problems and determine how the patient's health is disrupted by a health problem

  c. The nursing PoC using the nursing process provides a clinical decision support tool to enhance patient care outcomes

    (1) Nurses have the ability to improve the quality of patient outcomes by maximizing data interoperability using the CCC System as the example, so knowledge is accessible for nursing practice and documentation on the nursing PoC

    (2) As patients transition through the healthcare system, the nursing PoC data is modified and communicated

    (3) Not only does nursing PoC data support a continuum of care for the patient, it also provides a source of knowledge for care providers which may increase efficiency in the care process, improve care quality and decrease the cost of care across care settings

    (4) The nursing PoC provides nurses with a nursing process framework to care for patients that complements the patient's treatment plan and creates a healthcare environment of safety and patient-focused practice

d. The Nursing Process is the standard of practice and includes the following six phases
  (1) Assessment that includes the collection of comprehensive data pertinent to the patient's health or condition
  (2) The data is then analyzed to determine the nursing diagnosis or problem
  (3) The nurse then identifies the expected outcomes (goals) for each diagnosis for development of a care plan to attain the expected outcomes
  (4) The registered nurse implements the identified plan with ongoing evaluation of progress towards the attainment of the identified outcomes

e. The nursing process focuses on patient care processes provided by nurses and allied health personnel in clinical practice settings
  (1) "The nursing process operationalizes and demonstrates the art and science of nursing. The six phases of the nursing process describe the standard levels of nursing care and encompass all significant actions taken by nurses to provide care to patients/clients, and form the basis for clinical decision making"

f. The Nursing Process provides the framework for the nursing PoC and requires continual assessment and reassessment and the evaluation of patient responses or nursing interventions to achieve the identified nursing outcomes
  (1) Essentially there is no end to the Nursing Process or nursing PoC processes until a patient's healthcare needs are met
  (2) The Nursing Process remains focused on nursing PoC of the patient and adapted to meet patient needs and concerns

g. Other characteristics of the nursing PoC and Nursing Process framework include
  (1) Universally applicable
    i. Nursing Process framework is appropriate for any patient, of any age, with any clinical diagnosis, at any point on the health continuum and in any setting (e.g., school, clinic, hospital, or home) across all nurse specialties (e.g., hospice, maternity, pediatric, etc.)
  (2) Goal-oriented
    i. Nursing Process interventions are determined by the nursing diagnoses and chosen for the purpose of achieving the nursing outcome
  (3) Cognitive process
    i. Nursing Process involves nursing judgment and decision-making

h. The current 21st-century use of an electronic nursing PoC supports the role of nursing as a caring profession and dispels the depiction of technical and menu-driven profession and the computable structure of the CCC System promotes standard upgrades and versioning in existing clinical documentation systems
  (1) The implementation of a structured, standard, coded nursing terminology offers organizations a return on investment through transparency and insight into the value of nursing care (workload), resources (staffing), and care outcomes
  (2) The nursing PoC provides crucial information about patient care in healthcare regardless of the clinical setting
  (3) The nursing PoC informs healthcare professionals about care delivery plans among nursing, allied health providers for the integration of care and a data-driving understanding of care decision effects on quality outcomes

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Descriptions of "Other Plan of Care"

1. Overview
  a. A nursing PoC is an information standard "blueprint" for nursing and serves nurses and allied health professionals
    (1) A nursing PoC is a dynamic plan directly related to a patient's medical condition under clinical treatment and encouraged nurses to address "whole person" patient diagnosis(es) and problems that contributes a level of completeness in understanding nursing's contributions to patient care outcomes by providing a structured, coded, systematic view of patient-centered processes
  b. Currently, there are numerous commercial organizations and publishing corporations that are offering commercial electronic nursing PoC for uses in the EHR systems; however, that are similar to textbook chapters of nursing PoC being used in schools of nursing for educational purposes
    (1) The electronic PoC being offered generally are not using a coded nursing terminology compatible with the EHR system and thus retrieval of meaningful data for measuring outcomes is questionable
    (2) In fact meaningful data for analysis, reuse and /or aggregation to conduct research on and to generate evidence-based information may be not achievable
    (3) As a result the current focus is still on the standards organizations that are attempting to address the needs of MU Stage 3 for a "patient care plan" as described below by the HL7 Nursing Subcommittee and the IHE Patient Care Coordination (PCC) Committee
    (4) This new initiative has as a resource the PPOC approved by the IHE in 2010 as a possible model

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Care Planning Proponents

1. Health Level Seven International (HL7)
  a. HL7 is an SDO that states "care planning is a conceptual framework with many interrelated dependencies and antecedents"

 (1) The HL7 Nursing Subcommittee is collaborating with the IHE Patient Care Coordination (PCC) Committee on the details of a Care Plan that can be used by all healthcare professionals

 (2) The committees are discussing the "significant confusion and extensive debates over the different types of Care Plans: Care Plan, Plan of Care, and Treatment Plan"

b. Such care plans are likely to be understood and used in different ways depending on the preference, context of use, funding model, etc. under which they operate

Teaching Tip

Provide the example, "medicine generally refers to 'management plans' or 'treatment plans', midwifery has 'birthing plans', social care has 'support plans' and nursing and many other health and social professions refer to 'Care Plans', or 'Intervention Plans'. Increasingly guidance is proposing just one 'Care Plan' that can be used by all groups and by using a discipline identification code. Application functionality and descriptions may need to reflect these varying needs whilst combining the record together as an integrated care record."

c. "The benefit of care planning is enabling a multi-professional care plan used by teams across organization boundaries (primary, secondary, tertiary care)

 (1) A universal approach to care plan content will give a broad base to inform care plans and this approach should reduce the variation in care planning to support consistent, high quality, evidence based delivery of care"

 (2) Once finalized the multi-professional care plan is proposed to be integral component of MU Stage 3 which will be introduced in late 2014 and/or 2015

2. Standards & Interoperability (S&I) Framework

a. The S&I Framework approach from the ONCHIT, Office of S&I, is another initiative to create better care, better health, and cost reduction by care delivery improvements

b. The S&I Framework states

 (1) "A Care Plan is a consensus-driven dynamic plan that represents all of a patient's and Care Team Members' prioritized concerns, goals, and planned interventions. It serves as a blue print shared for all Care Team members, including the patient, to guide the Care Team Members (including Patients, their caregivers, providers and patient's care. A Care Plan integrates multiple interventions proposed by multiple provider and disciplines for multiple conditions"

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Healthcare Informatics Standard Groups

1. Overview

a. In 2008 Raths notes "If health information exchange is to get to the next level, formulating standards will be an absolute key"

 (1) The interest and involvement of the SDOs in demonstrating the implementation of data terminology standards for nursing care across all settings of care is crucial to providing the evidence of nursing care outcomes

 (2) The catalyst for the nursing PoC is the six standards or phases of the nursing process for documenting professional nursing practice using a standardized nursing terminology such as the CCC System

 (3) Descriptions of key informatics groups focusing on Meaningful Use standards are summarized below

2. Office of the National Coordinator for Health Information Technology

a. ONCHIT (www.healthit.gov) is a division of the Office of the Secretary, US DHHS with a focus on coordinating the adoption, implementation and use of health information technology, including the electronic exchange of health information, to achieve the "**triple aims"** of reform

 (1) "Better care (improve the overall quality, by making healthcare more patient-centered, accessible, and safe)

 (2) Healthy people/health communities (improve the health of the US population by supporting proven interventions to address behavioral, social and, environmental determinants of health in addition to delivering higher-quality care)

 (3) Affordable care (reduce the cost of quality healthcare for individuals, families, employers, and government reducing per capita costs of healthcare"

b. In order to provide funding to hospitals and Eligible Professionals for the demonstration of the "Meaningful Use" of electronic medical records, ONC developed the Nationwide Health Information Network (NHIN to advance the nation's health information infrastructure

 (1) The NHIN set standards and policies to enable a diverse set of federal agencies and nonfederal organizations to securely exchange electronic health information over the Internet

 (2) The NHIN is now the eHealth Exchange managed by nonfederal, nonprofit industry coalition

3. Standards & Interoperability (S&I) Framework

a. The S&I Framework was formed to enable healthcare stakeholders to improve the quality of healthcare through greater health information exchange

 (1) The S&I Framework, established by the DHHS, ONC is a public, private community forum focused on solving healthcare interoperability challenges through the establishment of "harmonized interoperability specifications that support national health outcomes and healthcare priorities, including MU, and the ongoing efforts to create better care, better population health and cost reduction through delivery improvement"

b. The S&I Framework has two key initiatives involving care plans: the S&I Longitudinal Coordination of Care (LCC) initiative that is focused on improving the transitions of patients across acute and post-acute care settings

c. The S&I Transition of Care (ToC) initiative was created to identify and develop healthcare standards that would enable the electronic exchange of core clinical information among providers, patients and other authorized entities to meet Stage 1 and Stage 2 MU ToC requirements

4. Longitudinal Coordination of Care Initiative
    - **a.** The S&I Framework Longitudinal Coordination of Care (LCC) Initiative provides an infrastructure to standardize transitions of care and care plan exchange across the continuum of care
    - **b.** The value of this initiative will be measured through the attainment of the following immediate and long-term outcomes are listed below
        - **(1)** Identification of functional requirements from a Use Case describing key conditions and business rules to enable transitions of care and care plan exchange, while protecting privacy and confidentiality
        - **(2)** Development of concise architectural guidance using easy-to-understand documentation, user-friendly tooling and formal models to assist providers, software vendors and others in applying technical requirements for transitions of care and the interoperable exchange of care plans
        - **(3)** Execution of one or more pilots to evaluate the specific use case for transitions of care and care plan exchange
        - **(4)** Development or identification of new national standards building upon existing and validated S&I ToC standards, and specific for: patient assessment summaries; priority transitions of care across the continuum of care; and care plan exchange
5. Transitions of Care Initiative
    - **a.** "The mission of the Transitions of Care (ToC) Initiative is to improve the exchange of core clinical information among providers, patients and other authorized entities electronically in support of meaningful use and IOM-identified needs for improvement in the quality of care"
        - **(1)** The initiative supports national health initiatives, key healthcare stakeholders and healthcare priorities and is driven by one compelling question: "What if every care transition was enabled by an unambiguously-defined core set of high-quality clinical data?"
        - **(2)** The ToC Initiative seeks to support MU 1 that specifies the exchange of key clinical information among providers of care and with patients and other authorized entities electronically based on level of system capability, i.e., human readable, unstructured text or full interoperable structured data
        - **(3)** "The ToC Initiative standards target specific provider groups or disciplines—eligible providers (EPs) and eligible hospitals (EHs)—and the software developers and vendors who would design or upgrade EHR systems to enable the exchange"
    - **b.** The S&I LCC Initiative "builds on the ToC Initiative standards and aims to address identified gaps in transitions of care and care planning"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- The voluntary participation by nurses in healthcare standards activities, groups, and committees achieved an increased level of data visibility of nursing in the healthcare standard activities
- As the nation moves toward fully operational health information record systems, nurses must know and understand how nursing care actions relate to other electronic data elements in the synthesis of information to improve patient care
- The Federal Office of Management and Budget current models of care are not aligned with the objective to provide the right care to the right patient at the right time
- Patient care data represent one of the largest gaps of data required by the CMS for inpatient hospital care which includes clinical documentation and the complexity of care performed by professional nurses
- It has been noted that clinical documentation may be the most critical factor in a patient's treatment and recovery and understanding the impact of care on outcomes may be the key to improving quality in today's healthcare system
- The ability to understand the relationship of nursing contributions to improving healthcare quality and the outcomes of patient care is uniquely nursing
- A description of the effects of nursing practice on patients through the analysis of standardized, coded nursing concepts benefits nurses by emphasizing the importance of collected, analyzed, and retrieved nurse data to support nursing practice recommendations for patient care
- The future for healthcare information systems involves expanding the capture of coded nursing data using a nursing terminology that follows the nursing process for each patient
- Nurses can use the nursing PoC to begin to tell a cohesive and accurate electronic patient story in an EHR that can be used for the Continuity of Care
    - Ambulatory care
    - Long-term careRehabilitation care (all care settings)
    - For the physician/provider's office
    - And for the patient at home
- Using coded nursing data allows for the analysis of nursing and patient outcomes data
- Clinicians will be able to use informatics tools and analytics to analyze the patient story (screened and filtered) and nurses can tell a patient's story and capture nursing data in coded manner at the point of care at the same time
- Nurses then have the quantitative evidence needed to measure the relationship of nursing interventions and actions documented to the nurse's impact on patient care using analytical displays of data to support performance-based nursing—and a scientific foundation for evidenced-based practice

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe structure for PoC in health information system
- Describe the complexity of nursing care and knowledge
- Discuss the nursing PoC standard for use in coded nursing care plans
- Describe educational framework for health information standards' initiatives
- Discuss standard for information retrieval of nursing PoC information
- Clarifies nursing process standard to which nurses are held accountable

Teaching Tip

Ask the students to define the keywords

- Nursing plan of care (PoC)
- Clinical Care Classification (CCC) System
- Meaningful use
- Nursing process
- Information standard
- Integrating the Healthcare Enterprise (IHE)
- American National Standards Institute (ANSI)
- Healthcare Informatics Standards Panel (HITSP)

CHAPTER REVIEW QUESTIONS

Question 26.1: Which best describes a Nursing Plan of Care (PoC) Standard?

a. Is a reference standard for the implementation of structured nursing data in electronic HIT systems

b. Represents the goal for the nursing care in HIT systems

c. Represents the research complexity of nursing care in HIT systems

d. Provides the basis for PoC research

Question 26.2: Which best describes the ANSI–HITSP Biosurveillance Committee role of analyzing "Use Cases" to select terminology standards for hospitals?

a. To develop "Use Cases" that depicted terminologies used for federal (CMS) reimbursement

b. To identify the healthcare standards required for the electronic documentation of patient care and interoperable with other systems

c. To identify the nursing standards that were only interoperable with other systems

d. To review and analyze standards that focused on identifying physician orders

Question 26.3: Once a HITSP selected a standard the IHE was solicited to develop a methodology for the patient plan of care (PPOC)? Select True or False.

a. The PPOC recognized the family–centric as the focus of healthcare True ___ False ___

b. The PPOC described the data needed by nurses for documentation in an EHR True ___ False ___

c. The PPOC formalized the data requirements for nurses for efficient and timely capture of care events True ___ False ___

d. The PPOC was designed for only non-clinicians workflows True ___ False ___

e. The PPOC used the CCC Information Model in its scenario True ___ False ___

Question 26.4: Which best describes how a nursing PoC could impact Meaningful Use?

a. It could standardize the medical care treatment processes True ___ False ___

b. It could, using the Nursing Process framework, describe its minimum patient care requirements True ___ False ___

c. It could generate HIT reports of the patient progress True ___ False ___

d. It could automatically create the status report as needed True ___ False ___

e. It could initiate patient orders for medications, radiology, etc. True ___ False ___

Question 26.5: What are the six phases of the Nursing Process as outlined by the ANA?

a. Signs/Symptoms, Problems, Goals, Plan of Care, Provide Interventions Actions, and Measure Outcomes

b. Assessment, Diagnosis, Expected Outcome, Planning, Implementation and Actual Outcomes

c. Assessment, Diagnosis, Outcome Identification, Planning, Implementation, and Evaluation

d. Signs/Symptoms, Diagnosis, Goal, Care Plan, Intervention/Actions, and Measure Outcomes

Question 26.6: Which statement best describes a nursing PoC using the Nursing Process?

a. The nursing PoC using the Nursing Process provides a pain tool

b. The nursing PoC using the Nursing Process provides basis for ADL scale

c. The nursing PoC using the Nursing Process supports the continuum of care from inpatient, to outpatient, to home

d. The nursing PoC using the Nursing Process generates home health referrals

Question 26.7: What are the three other major characteristics of a nursing PoC using the Nursing Process Framework?

a. The Nursing Process Framework is not appropriate for any patient

b. The Nursing Process Framework is appropriate for any patient: Is Universally Applicable, Goal-Oriented, and Cognitive Process

c. The Nursing Process Framework is appropriate for any patient that has an electronic health record

d. The Nursing Process Framework is not appropriate for a patient with an electronic health record

Question 26.8: How is Health Level Seven International (HL7) Nursing Subcommittee involved in the care planning initiative?

a. Is collaborating with the ANSI-HITSP Committee re the details of the care planning initiative

b. Is collaborating with the S&I Office of the ONC re the details of the care plan for all healthcare professionals to use

c. Is collaborating with the IHE Patient Care Coordination (PCC) Committee on the details of a care plan that can be used by all healthcare professionals

d. Is collaborating with the ANA on the Care Planning initiative

Question 26.9: Which are the triple aims of reform that the ONC is responsible for the electronic exchange of health information to achieve?

a. To provide Safe Care, Quality Care, and Affordable Care

b. Better care, Affordable Care, and Healthy People/ Healthy Communities

c. Patient-Center Care, Accessible Care, and Affordable Care

d. Healthy People/Healthy Communities, Quality Care, and Nursing Care

Question 26.10: The largest gap in CMS data bases are HIT is professional nursing care data of primarily in-hospital patients. What benefits does the value of a standardized, coded, nursing terminology that follows the nursing process to document and support nursing practice provide?

a. Allows for analysis of nursing and patient care outcomes True ___ False ___

b. Allows for the capture of coded nursing data at the point of care True ___ False ___

c. Provides quantitative evidence needed to measure the relationship of nursing interventions and actions to outcomes True ___ False ___

d. Generates data that provides evidence-based practice True ___ False ___

e. Generates data that can measure workload and cost True ___ False ___

ANSWERS AND EXPLANATIONS

Question 26.1: (a) Is a reference standard for the implementation of structured nursing data in electronic HIT systems. Nursing standards reflect the information insights of Florence Nightingale who through her groundbreaking work in informatics founded nursing as a theory-based, scientific profession with an independent body of knowledge and wisdom. She focused on quality indicators of patient care and measures of care which led to the development of nursing standards as the framework for care accountability in nursing.

Question 26.2: (b) To identify the healthcare standards required for the electronic documentation of patient care and interoperable with other systems. In analyzing the "Use Cases" for Biosurveillance nurses noted that most terminology standards in hospitals were used for the reimbursement of medical services and terminology used for patient care processes performed by nurses were overlooked and a missing "gap" from the national dialog. Thus the committee selected the Clinical Care Classification (CCC) System as the first national nursing terminology that was interoperable for the documentation of patient care.

Question 26.3:

a. False

b. True

c. True

d. False

e. True

The PPOC is an IHE profile describing the data concepts needed by nurses for the documentation in the electronic health record

Question 26.4:

a. False

b. True

c. False

d. True

e. False

The nursing PoC identified a missing and essential professional component for the electronic documentation of nursing practice. The nursing PoC standard used the CCC System to name, describe, and code the "Essence of Care" which refers to the documentation of the primary reason including the essential nursing care needs for providing patient care for a specific condition.

Question 26.5: (c) Assessment, Diagnosis, Outcome Identification, Planning, Implementation, and Evaluation. The nursing PoC using the Nursing Process framework provides a complete minimum requirements for a plan of care field (problem). It could generate a status report of the status of the patient and any point in time, updated and revised based on specific clinical requirements and addressed in the clinical decision support systems.

Question 26.6: (c) The nursing PoC using the Nursing Process supports the continuum of care from inpatient, to outpatient, to home. As described above the nursing PoC offers a readily available standard to summarize the quality care as part of each Clinical Quality Measure's Description for the transition of care (ToC) along with the continuum of care.

Question 26.7: (b) The Nursing Process Framework is appropriate for any patient: Is Universally Applicable, Goal-Oriented, and Cognitive Process. The Nursing Process remains focused on nursing PoC of the patient and adapted to meet the patient needs and concerns. It is Universally Applicable since it is appropriate for any patient, of any age, with any clinical diagnosis, at any point in the continuum across all nursing specialties. It is goal–oriented because the nursing process interventions are determined by the nursing diagnoses and chosen for the purpose of achieving the nursing outcomes. It also involves nursing judgment and decision-making depicting the Cognitive Process.

Question 26.8: (c) Is collaborating with the IHE Patient Care Coordination (PCC) Committee on the details of a care plan that can be used by all healthcare professionals. The HL7 and IHE PCC Committees are discussing the "significant confusion and extensive debates over the different types of Care Plans: Care Plan, Plan of Care, Treatment Plan, etc."

Question 26.9: (b) Better Care, Affordable Care, and Healthy People/Healthy Communities. The "triple aims" of reform: (1) Better Care to improve the overall quality of making healthcare more patient-centered, accessible, and safe; (2) Healthy People/Healthy Communities to improve the health of the US population by supporting proven interventions to address behavioral, social, and environmental determinants of health in addition to delivering higher quality care; and (3) Affordable Care to reduce the cost of quality healthcare for individuals, families, employers, and government reducing per capita costs of healthcare.

Question 26.10:

a. True
b. True
c. True
d. True
e. True

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Computerized Provider Order Entry

• OBJECTIVES

1. The reader will be able to state two reasons why CPOE is different from other healthcare information technology implementations.
2. The reader will be able to state at least three common barriers to a successful CPOE implementation.
3. The reader will be able to state at least three strategies to ensure a successful CPOE implementation.
4. The reader will be able to state at least two future possible directions of CPOE.
5. The reader will be able to state three core competencies required of the nurse informaticist working with CPOE.

• KEY WORDS

CPOE
ARRA
HITECH
Meaningful use
Change management

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Who enters orders into the electronic health record (EHR)? How could order entry be improved? What federal initiative has promoted the adoption of CPOE? What are potential problems with the implementation of CPOE?

For a WIIFM statement, say to the class, "This chapter discusses a brief history of CPOE and its recently renewed significance on a national level with the passage of HITECH. Benefits of CPOE have been long established; however the HITECH offers new incentives to promote widespread adoption more rapidly. A successful CPOE implementation methodology is critical to fully realizing the vision of the HITECH. This chapter addresses common barriers to a successful implementation of CPOE and strategies to overcome those barriers. A patient safety framework is also reviewed in order to avoid any unintended consequences that arise as the result of a new technology implementation. Finally, the chapter sets the stage for the future of CPOE, including the required core competencies of the nurse informaticist to leading this type of implementation today and tomorrow." As a nurse, it is important to know the usefulness of CPOE as well the limitations.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites related to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1 No pretest for this chapter

CHAPTER OUTLINE

CPOE: Computerized Provider Order Entry

1. Overview
   a. Much of the attention paid to CPOE has historically been associated with early adopters at academic medical centers such as Brigham and Women's Hospital and leading community sites such as El Camino Hospital reporting on their experience with clinical information systems in the 1980s and 1990s
      (1) In 2000–2001, through the publications of the Institute of Medicine's *To Err is Human* and *Crossing the Quality Chasm* and the subsequent focus of the Agency for

Healthcare Research and Quality (AHRQ) on preventing medical errors this past decade, CPOE received renewed attention as a patient safety tool

- **(2)** The private sector, simultaneously through employer organizations such as the Leapfrog Group for Patient Safety, has also pursued a similar agenda
- **(3)** Each consistently recommends the use of CPOE to improve healthcare quality
- **(4)** Benefits often highlighted range from the simple help of physician order legibility to the more complex decision support related to allergy and interaction checking, medication dosing guidance, and in some cases culminating in an overall decrease in patient mortality and significant financial return on investment

b. A new dimension of CPOE has emerged with the passage of the Health Information Technology for Economic and Clinical Health Act of 2009 (HITECH)

- **(1)** As part of the American Recovery and Reinvestment Act of 2009 (ARRA), the aim of HITECH is to promote the adoption and meaningful use of health information technology (HIT)
- **(2)** Included in HITECH are financial incentives to physicians and healthcare organizations that utilize EHRs, including CPOE
- **(3)** These incentives initially have come in the form of increased reimbursement rates from the Centers for Medicaid and Medicare Services (CMS), but will ultimately result in a penalty if adoption and meaningful use of the EHR are not met
- **(4)** The Department of Health and Human Services (DHHS) has now published two sets of criteria and objectives for the meaningful use of EHR technology
- **(5)** The first set was published in July 2010, the second in September 2012
- **(6)** A third set is expected to be published sometime in 2016
- **(7)** The three stages are intended to promote data capture and sharing across healthcare entities, advance clinical processes, and improve clinical outcomes

Teaching Tip

Review that this chapter discusses a brief history of CPOE and its recently renewed significance on a national level with the passage of HITECH. Benefits of CPOE have been long established; however the HITECH offers new incentives to promote widespread adoption more rapidly. A successful CPOE implementation methodology is critical to fully realizing the vision of the HITECH. This chapter addresses common barriers to a successful implementation of CPOE and strategies to overcome those barriers. A patient safety framework is also reviewed in order to avoid any unintended consequences that arise as the result of a new technology implementation. Finally, the chapter sets the stage for the future of CPOE, including the required core competencies of the nurse informaticist to leading this type of implementation today and tomorrow.

c. The significance of CPOE cannot be underestimated

- **(1)** Although CPOE implies a physician or a provider-centric tool, the workflow and subsequent management of those patient care orders involves the entire interdisciplinary team, with the nurse at the center as patient care coordinator
- **(2)** CPOE is also often the foundation for standardizing care delivery and best clinical practices, along with being an important component of advanced decision support
- **(3)** As such, in addition to the broader backdrop of patient safety, quality and now financial incentives, it is essential to recognize the impact of CPOE on the work of the nurse and the significance of the nursing informaticist in obtaining a core competency in CPOE

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Definition of CPOE

1. Overview

a. CPOE is often used as an abbreviation to represent how an EHR system requires an end user to electronically enter patient care orders and requests

- **(1)** There have been electronic order communication tools available in the past that allowed for the transmission of lab, radiology, medication, and other types of orders to downstream ancillary systems
- **(2)** However, they relied largely on the transcription of a handwritten physician note by a department secretary, nurse, or pharmacist and offered limited rules checking or clinical decision support (CDS) capacity

b. The “P” in CPOE has most commonly stood for Provider, but will also appear as Physician or Prescriber

- **(1)** This is what makes CPOE different from basic electronic order submission
- **(2)** The transcription step is removed, and the provider places the order directly into the system
- **(3)** By using Provider it is also implied that the user placing the order is authorized to give or sign that order and leaves room for other disciplines in addition to physicians who have a scope of practice that supports CPOE, such as advanced practice nurses and physician assistants

c. CPOE is also different in that it is inherently tied to a CDS system that enables the checking and presentation of patient safety rules during ordering, such as drug-drug interaction checking, duplicate checking, corollary orders, and dose calculations

- **(1)** The “E” is also sometimes replaced by an “M” and stands for computerized physician order management or computerized provider order management, further implying that these orders are no longer once and done, but will require on-going review and updating in the context of rules, alerts, and other feedback mechanisms an EHR may provide that paper and pen cannot

   (2) Management of an order also implies that it is more than simply entered, but also communicated to other care team members, reviewed, and acted upon

d. In 2005, Dr. Michael McCoy proposed three types of CPOE: basic, intermediate, and advanced

   (1) Basic incorporates order entry with simple decision support features such as allergy or drug-drug interaction checking

   (2) Intermediate level CPOE includes additional relevant results display at the time of ordering and the ability for providers to save their order preferences

   (3) Dr. McCoy considered advanced CPOE to represent advanced clinical order management, and it is here that more sophisticated decision support in the form of "guided ordering" or "mentored ordering" would be available

e. The definition chosen for CPOE is important to clarify, as it will impact the scope of the CPOE implementation and the related design, build, testing, and training requirements

   (1) Will it be basic or advanced?

   (2) Will it include physicians only or all clinicians more broadly?

f. The definition and standards are also significant as healthcare organizations are now required to benchmark themselves to national HITECH Meaningful Use metrics

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Implementation

1. Overview

   a. Implementing CPOE, in many ways, is not unlike other health information technology projects

      (1) It requires a project plan, with appropriate time to complete workflow analysis, build, testing, and training

      (2) Like other HIT projects, the most successful implementations have a change management plan that facilitates end-user adoption of the new technology

      (3) CPOE, however, is unlike other HIT projects in that it often impacts the healthcare organization on a much broader and deeper scale than, for example, activating a clinical data repository, Picture Archiving and Communication System (PACS) or a clinical notes dictation system

      (4) CPOE is at the heart of patient care and cannot be done in isolation to one department or discipline as it ultimately demands not only a new medium in which providers will work—the EHR—but also a new way in which to work

      (5) Babbott et al. (2014) discuss that physicians working with a fully functioning EHR including CPOE could be presented with multiple tasks ranging from preventative health reminders to required documentation, and that although this may lead to a more accurate assessment than on paper it calls into question if current practice patterns can sustain this "contemporary" approach

      (6) CPOE has only recently become an accepted tool as routine as using a stethoscope for new healthcare professionals

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Common Barriers to Successful Adoption

1. Overview

   a. Despite the recent, rapid expansion of CPOE in the wake of Meaningful Use, a review of the literature suggests that there are still segments of providers where the "digital divide" persists and adoption remains low

      (1) Those at greatest risk include small, primary care practices, frequently owned by physicians and with some evidence suggesting a greater proportion of patients that are Medicaid, minority, or uninsured

      (2) These sites frequently do not have the practical knowledge to implement a CPOE system, apply quality improvement methods to achieve benefits from it or sustain maintenance

      (3) Critical access and smaller hospitals are also at risk due to a low patient volume that limits the organization's ability to apply operational resources to a CPOE implementation, recruit and retain skilled IT personnel and difficulty finding a suitable vendor that can successfully accommodate these limitations

   b. The literature also suggests that "four main drivers influence a providers' decision on EHRs: affordability; product availability; practice integration; and provider attitudes

      (1) HITECH addresses the first three, but providers' attitudes (that are) critical to the success of the act are beyond the legislation's control"

      (2) And that despite established benefits of an EHR; the implementation can still be disruptive and require a steep learning curve for providers to use the features effectively

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Strategies for a Successful Adoption

1. Overview

   a. A number of studies and reports have been written about successful implementation strategies for CPOE

      (1) Written in 2000, *A Primer on Physician Order Entry* cited executive leadership, physician involvement, a multidisciplinary approach to implementation, good EHR system response time and flexible

training strategies as the keys to a successful CPOE implementation

    (2) A more recent study that focused on supporting those provider practices most at risk for successful CPOE adoption reinforced those strategies with eight specific implementation tactics including building relationships to gain the trust of providers that will support the change, hiring staff that understand the domain of the physician practice, setting realistic expectations and obtainable goals, ensuring there is enough physical space for hardware so that providers may work effectively, aligning the organization's vision with the goals of the implementation, developing a business case to identify the expected benefits of CPOE, planning for provider practice redesign and creating a sustainable support model for on-going improvement efforts

b. Given the barriers to and strategies for successful adoption of CPOE outlined here, the work of a nurse informaticist in a CPOE implementation will draw on all aspects of nursing informatics practice as defined by the American Nurses Association (ANA); however, as a consultant the nurse informaticist may add the greatest value to solving the complex issues of CPOE through expert domain knowledge, change management theory and planning, process improvement methods and patient safety review

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Domain Knowledge

1. Overview

- **a.** Nurses understand many of the physicians' work processes and along with nurse informaticists are in a unique position to assess the impact of new CPOE workflows through communication, coordination, and knowledge sharing
    - **(1)** Two observations from nurse leaders highlight the importance of this role for ensuring no interruption to patient care, effective care team processes and generally aiding the provider using CPOE for the first time
- **b.** The first leader said:
    - **(1)** "the planning team spent a great deal of time learning all that nurses did to actualize a physician order prior to CPOE. We also recognized the importance of focusing on the output of CPOE to ensure that it supports effective nursing practice"
    - **(2)** The second leader explained: "our nursing staff was part of the initial phase roll out of CPOE. This built in support system has been a critical factor in driving physician adoption"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Change Management

1. Overview

- **a.** In addition to ensuring a reliable order management workflow, nurses' domain knowledge also enables the nurse informaticist to plan and support an effective series of change management activities
    - **(1)** Change management and communication activities should be a part of each implementation phase starting as early as planning and continuing past the activation of the new system; as project milestones, each activity should build on each other toward unifying providers and the entire care team, solidifying their readiness for a new way of working with CPOE
    - **(2)** The requirement of a comprehensive change management plan is well stated by Studer, who completed an extensive literature review of effectiveness of EHR implementations and concluded that organizational factors must be considered before, during, and after the implementation in order to promote successful adoption
    - **(3)** One of those organizational factors is readiness for change
    - **(4)** "In practical terms, readiness for change requires both a willingness and capacity to change"
        - **i.** Holt, Helfrich, Hall, and Weiner (2010) suggest three broad dimensions of organizational readiness to be considered when planning an implementation project and in selecting a method for assessing it
        - **ii.** These include psychological factors, structural factors, and the level of analysis
    - **(5)** Several instruments are available to assess readiness to change and the nurse informaticist may help identify the best tool by assessing those being asked to change, the factors under which the change is being made and the level of impact the change will be felt either individual or organization
- **b.** The need for a sustained change management plan after the implementation was supported in a survey of providers using an EHR
    - **(1)** The "high EMR cluster" of providers had a significant correlation to higher stress levels and lower job satisfaction
    - **(2)** Achieving the expected benefits of CPOE is dependent on a provider's ability not only to survive and but also thrive in the "high EMR cluster"
    - **(3)** The nurse informaticist may apply basic usability theory and process improvement methods to identify areas of work redesign that may ease the transition and promote realizing benefits sooner

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Usability, Patient Safety, and Process Improvement Methods

1. Overview

a. Despite the many positive outcomes related to EHR implementations, the literature does note negative, unintended consequences of system implementations that cannot be ignored

(1) Along with reports of usability also being a barrier to adoption of EHR and the expected increase in EHR development and use as a result of HITECH, the AHRQ funded research in 2009 and 2010 to establish a common set of recommendations, use cases, policy, and research agenda items related to the usability of EHR systems

(2) AHRQ categorized the functions of an EHR into four roles: memory aid, computational aid, decision support aid, and collaboration aid

(3) How well the EHR can support these functions and a clinician using them in a complex care environment is a direct result of the system's design and usability

b. Usability is a quality attribute that assesses how easy user interfaces are to use

(1) There are many quality attributes that represent usability, and for the purposes of CPOE usability, those to focus on include learnability, efficiency, errors, satisfaction, and utility

(2) Usability expert Jakob Nielsen stresses that it is better to run several small tests in an iterative approach, where five end users are typically enough to identify the most important usability problems

(3) There are three types of testing activities that will promote system usability: a gap analysis between current and future state content and workflows, shadowing a provider real-time working in current state with the new CPOE system testing future state and care team simulation

(4) AHRQ further recommends that these types of tests are organized around a specific framework of use cases including acute episodes, chronic conditions, preventative and health promotion, and undifferentiated symptoms

(5) The combination of measuring these usability attributes through different types of testing activities that are organized around common use cases should capture the high risk and high volume workflows related to CPOE and EHR use broadly

c. Any usability problems that arise from testing should be seen as an opportunity to drive possible work redesign, CPOE system enhancements, and training and change management efforts

(1) If problems cannot be solved, then goals and expectations of the CPOE implementation must be recalibrated to reflect something more realistic including the potential of not implementing a specific feature or workflow if the risk to safe and reliable patient care may be compromised

d. Sustained process improvement methods post-live implementation will further support new usability case studies and successful adoption

(1) The Plan-Do-Study-Act or PDSA model as developed by Associates in Process Improvement can be a helpful framework for guiding this type of work

(2) The PDSA approach would facilitate assembling a team to define the problem, set an improvement goal, brainstorm possible solutions, choose and test a subset of solutions in order to identify which solutions are most effective, and then spread those changes to address the problem broadly

(3) The process may be iterative and starting small and then expanding scope ensures both judicious use of resources and acceptance of the change

e. Although the primary goal of these activities is to ensure a safe, reliable CPOE system technical build and to anticipate and plan for the work redesign required of providers, a secondary goal is equally important

(1) These activities also engage the providers and those end users impacted by the changes made by CPOE in a way that enables building relationships of trust with the informatics and information technology team

(2) This is accomplished by identifying and meeting the provider and care team needs that surface during the testing and improvement work, and if unable to meet the needs clearly communicating a risk mitigation plan

(3) The work also simultaneously develops the core competencies required to not only configure and maintain a CPOE system technically, but also to lead and manage professionally through this enormous change for the entire healthcare organization

(4) The cumulative benefits, and subsequent risk mitigation, of usability testing and post-live PDSA efforts make the investment well worth the expense for guiding the CPOE implementation toward healthcare transformation and away from simple automation of current state practice

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Future Directions

1. Overview

a. There is no doubt that CPOE will be an important feature and function of EHRs for the foreseeable future

(1) As noted previously, recent, renewed attention to the adoption of CPOE at a national level with the passage of ARRA has solidified CPOE's position as significant to the delivery of healthcare of the future

(2) The increased number of providers using CPOE alone will change the course of future development in this area, not to mention advances in software, hardware, and interoperability standards

b. As coordinated care becomes the gold standard for healthcare delivery, pharmacists and nurses are working to their full scope of practice and partnering with physicians to facilitate key CPOE processes such as medication reconciliation and orders management

- **(1)** Pharmacists and pharmacy techs are collecting medication history, dispensing discharge prescriptions to ensure continuity of care and educating patients on medication management
- **(2)** Nurses and other interdisciplinary team members such as respiratory therapists and nutritionists are now not only clarifying orders and implementing prescribed interventions, but are also making recommendations through order entry as pended, protocoled, or suggested sets that a physician may accept or decline
- **(3)** This collaboration will only continue to grow and will support both improved provider productivity with CPOE and greater accuracy in the plan of care for a patient

c. Increasing patient engagement is another core component to healthcare reform and may include a new role for patients in the future of CPOE

- **(1)** Although medication reconciliation has historically been the domain of providers, a recent pilot study conducted by the VA Boston Healthcare System enabled patients to electronically verify their medication list post discharge
- **(2)** This virtual medication reconciliation avoided potential adverse drug events and reinforced the patient's desire to partner directly with their physician in all aspects of their care

d. The focus of CPOE software development has been oriented to improving basic usability and addressing specific workflow concerns, such as medication reconciliation

- **(1)** In the future, the focus will be on making CPOE systems smarter and able to better anticipate the providers' next action based on past patterns of use
- **(2)** In addition, CDS will continue to become more robust and patient specific, but with it will be a more elegant management of alerting to avoid alert fatigue

e. Hardware platforms for personal computing are an exciting area to watch for the future of CPOE

- **(1)** Providers will be able to choose from a wide range of devices in size and portability that will be increasingly enabled for touch screen and tailored to the unique information needs of a specialty, such as intensive care, surgery, or oncology
- **(2)** There will be continued improvement of integration between telecommunication systems and EHR software that will facilitate increased remote alerting, monitoring, and access capabilities

f. As interoperability standards between EHR systems improve, it is quite possible that resurgence in a "best of breed" vendor approach to EHR software modules could occur

- **(1)** It would require a significant expansion of data exchange standards beyond medication, allergy and problem lists, but it is not unfathomable, considering the leaps in HIT standardization in the past five years alone
- **(2)** In the meantime, it is certain that interoperability will expand the provider's accountability for considering and reconciling patient historical data as EHR systems are already passing discreet medication, allergy and problem list data to be consumed downstream by other EHRs and the providers using them

g. Research related to the impact of CPOE adoption on this new scale, along with the use of electronic health records broadly by setting and type of provider will be critical to guiding the future of CPOE

- **(1)** And the nurse informaticist has much to contribute to shaping that future as leaders of health information technology implementations

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Core Competencies of the Nurse Informatacist in CPOE

1. Overview

a. Sensmeier summarized the demand for nursing informatics professionals in 2006 and quoted the American Medical Informatics Association (AMIA) Chair, Charles Safran, MD as stating that every hospital and care setting needs one (nurse informaticist) in order to meet the government's vision for EHRs

- **(1)** This is further reinforced in the 20th Annual HIMSS Leadership Survey where "half of healthcare IT professionals indicated that a focus on clinical systems will be their organizations' top IT priority in the next year, with a specific focus on EMR and CPOE technology"
- **(2)** A significant barrier identified by the survey was a lack of IT staffing, particularly in application level support and process/workflow design

b. Application level knowledge represents the ability to assemble the building blocks of a clinical information system in the most effective way to meet the needs of the end user

- **(1)** This skill will primarily rely on the nurse informatacist's ability to assess, plan, and implement
- **(2)** In the case of CPOE, this will require not only technical competency for the purposes of designing and building the workflows to deliver patient care orders into the application, but also content management knowledge to standardize those orders and reinforce them with evidenced-based practice
- **(3)** More broadly, application level knowledge also includes the ability to assess the integration points and impact of a particular application like CPOE with other applications like a results interface or pharmacy information system

c. As discussed, the nurse informatacist as consultant will also possess the domain knowledge of CPOE workflows and clinical process that is essential for successfully translating and aligning the needs of the end user, the patient, and the healthcare organization into the application, and leveraging its features and functions to meet those needs

- **(1)** As no single nurse informaticist can know everything about all of an organization's processes or physician practice, workflow analysis skills draw on the nurse's underlying ability to interview clients for their history, complete an assessment, and collaborate across disciplines to meet a common goal

- **(2)** These are skills that would have been learned in nursing school for the purposes of patient care, and here scale for the purposes of ensuring the best outcomes for the organization utilizing the CPOE being implemented

Teaching Tip

Provide the example, a nurse would never implement a plan of care for a patient simply based on diagnosis alone. So too a nurse informaticist would never implement CPOE simply based on one provider or one department.

- **d.** The nurse informaticist as consultant can also assess the need for and establish a change management plan for CPOE
  - **(1)** These skills are also learned by nurses early in their clinical careers, as they relate to providing patients with education about their plan of care
  - **(2)** This may include anticipatory guidance for changes large and small to a patient's lifestyle, daily routine, relationships, and perception of themselves
  - **(3)** The nurse's ability to establish a healthy, trusting relationship with the client is at the core of successful patient education
  - **(4)** Preparing an organization for the changes related to CPOE is at its core fundamentally not that different
  - **(5)** However, the scale is significantly bigger and broader as the learning styles, motivators, and metrics of success for the CPOE implementation will vary widely across providers, patients, the interdisciplinary team, and the organization itself. Subsequent "coping mechanisms" for the CPOE changes will also vary by organization based on culture, infrastructure, available resources, and the ability to apply those resources
  - **(6)** The nurse informatacist working with CPOE is competent in assessing an individual's and an organization's readiness to change, can employ basic usability and process improvement methods to anticipate the impact of the change, and lead through the change in a positive, constructive way
- **e.** Ensuring a usable system that promotes patient safety and provider adoption is another primary requirement for the nurse informaticist implementing CPOE
  - **(1)** Familiarity with the heuristics of usability along with the ability to assess common high risk and high volume use cases for unintended consequences will ensure that benefits of the implementation are realized reliably and without causing undue harm
- **f.** National healthcare policy review has often been reserved to the scope of practice of nurse leaders in management or academia
  - **(1)** The expert nurse in CPOE, however, can no longer isolate him or herself from the of work government on healthcare information technology
  - **(2)** As stated previously, the implications of healthcare reform and HITECH are now more than ever tightly intertwined with the daily care of patients and the clinical information systems that support that care delivery
  - **(3)** While an advanced degree in healthcare policy is not necessary, the competent nurse informaticist should understand the regulatory and compliance landscape, and its impact on clinical processes and applications as this will always be an influence on his or her future work

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- CPOE remains one of the most challenging areas within healthcare IT today, and yet it has the promise of significant benefits to both patient and provider making it an area of potential great professional reward
- CPOE systems have improved over the years and will only continue to become more user-friendly and sophisticated in their CDS capabilities as the demand increases from broader adoption
- Cultural barriers to CPOE implementation will also shift as adoption becomes required to demonstrate meaningful use of an EHR
- With core competencies of systems knowledge, workflow analysis, change management, usability theory, process improvement methods, human factors and healthcare policy, the nurse informaticist will be well positioned to support CPOE implementations today and shape the systems of tomorrow

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- The reader will be able to state two reasons why CPOE is different from other healthcare information technology implementations
- The reader will be able to state at least three common barriers to a successful CPOE implementation
- The reader will be able to state at least three strategies to ensure a successful CPOE implementation
- The reader will be able to state at least two future possible directions of CPO
- The reader will be able to state three core competencies required of the nurse informaticist working with CPOE

Teaching Tip

Ask the students to define the keywords

- CPOE
- ARRA
- HITECH
- Meaningful use
- Change management

CHAPTER REVIEW QUESTIONS

Question 27.1: CPOE is defined as _______________?

- **a.** Computerized Patient Outcome Enterprise
- **b.** Computerized Provider Outcome Enterprise
- **c.** Computerized Provider Order Entry
- **d.** Computerized Patient Order Entry

Question 27.2: State two reasons why CPOE is different from other healthcare information technology implementations.

- **a.** (1) The transcription step is removed, and the provider places the order directly into the system , and (2) CPOE is inherently tied to a CDS system that enables the checking and presentation of patient safety rules during ordering, such as drug-drug interaction checking, duplicate checking, corollary orders, and dose calculations
- **b.** (1) CPOE is focused on patient-centric results, and (2) CPOE is tied to achieving positive patient outcomes
- **c.** (1) The transcription step is removed, and the patient places orders directly into the system, and (2) CPOE is tied to patient safety
- **d.** None of the above

Question 27.3: State three strategies to ensure successful implementation of a CPOE.

- **a.** A project plan, a long term strategy and, and a training plan
- **b.** A workflow analysis, a short term strategic plan, and a testing strategy
- **c.** A project plan, a change management strategy, and a good RFP

Question 27.4: What are three types of testing of a new CPOE system?

- **a.** A gap analysis between current and future state content and workflows, shadowing a provider real-time working in current state, with the new CPOE system testing future state and care team simulation
- **b.** The usability of the system, a gap analysis, and workflow analysis
- **c.** A gap analysis, a functional requirements analysis, and a workflow analysis
- **d.** The usability of the system, a gap analysis, and a functional requirements analysis

Question 27.5: What is a potential future direction of CPOE?

- **a.** Increasing patient engagement is another core component to healthcare reform and may include a new role for patients in the future of CPOE
- **b.** Increasing the content in the CPOE to include European drug standards
- **c.** Increasing the drug standards in the CPOE(d) None of the above

Question 27.6: State one of the core competencies required of the nurse informaticist working with CPOE.

- **a.** Having worked in clinical practice over 25–30 years is a core competency
- **b.** Application level knowledge is a core competency of the nurse informaticist working with CPOE
- **c.** Having an advanced degree in nursing informatics is a core competency
- **d.** There are no core competencies required to work with CPOE

Question 27.7: True or False. One of the application level knowledge skills of the nurse informaticist working with CPOE is the ability to assess, plan, and implement which is a part of the nursing process standard.

Question 27.8: What does content management knowledge include?

- **a.** The ability to standardize the orders and reinforce them with evidenced-based practice
- **b.** The ability to conduct outcomes research on the CPOE
- **c.** The ability to test and evaluate the CPOE
- **d.** The ability to standardize the order with global CPOE

Question 27.9: Name one barrier/risk to implementing CPOE.

- **a.** The large metropolitan hospital that has too many pharmacies to link CPOE to
- **b.** The retail clinic that are too small to utilize CPOE
- **c.** Those at greatest risk include large metropolitan hospitals that have no EHR
- **d.** Those at greatest risk include small, primary care practices, frequently owned by physicians and with some evidence suggesting a greater proportion of patients that are Medicaid, minority, or uninsured

Question 27.10: According to the ANA, what set of skills is the greatest value of the nurse consultant in CPOE?

- **a.** The nurse informaticist may add the greatest value to solving the complex issues of CPOE through expert domain knowledge, change management theory and planning, process improvement methods, and patient safety review
- **b.** The nurse informaticist may add the greatest value by having over 25–30 years in clinical practice
- **c.** The nurse informaticist may add the greatest value knowing change theory alone
- **d.** The nurse informaticist may add the greatest value knowing usability and testing theories

ANSWERS AND EXPLANATIONS

Question 27.1: (c) Computerized Provider Order Entry.

Question 27.2: (a) (1) The transcription step is removed, and the provider places the order directly into the system , and (2) CPOE is inherently tied to a CDS system that enables the checking and presentation of patient safety rules during ordering, such as drug-drug interaction checking, duplicate checking, corollary orders and dose calculations.

Question 27.3: (d) CPOE implementation requires a project plan, with appropriate time to complete workflow analysis, build, testing, and training. Like other HIT projects, the most successful implementations have a change management plan that facilitates end-user adoption of the new technology.

Question 27.4: (a) AHRQ recommends a gap analysis between current and future state content and workflows, shadowing a provider real-time working in current state, with the new CPOE system testing future state and care team simulation.

Question 27.5: (a) Increasing patient engagement is another core component to healthcare reform and may include a new role for patients in the future of CPOE.

Question 27.6: (b) Application level knowledge is a core competency of the nurse informaticist working with CPOE.

Question 27.7: True. The application level knowledge skills of the nurse informaticist working with CPOE include the ability to assess, plan, and implement which is a part of the nursing process standard.

Question 27.8: (a) The ability to standardize the orders and reinforce them with evidenced-based practice.

Question 27.9: (d) Those at greatest risk include small, primary care practices, frequently owned by physicians and with some evidence suggesting a greater proportion of patients that are Medicaid, minority, or uninsured.

Question 27.10: (a) The nurse informaticist may add the greatest value to solving the complex issues of CPOE through expert domain knowledge, change management theory and planning, process improvement methods, and patient safety review (ANA, 2008).

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28

Physiological Monitoring and Device Interface

• OBJECTIVES

1. Describe the importance of medical device connectivity.
2. Define components of medical device interface devices.
3. Understand issues and challenges of infusion management and Smart Pumps.
4. Introduce Smart Room technology.
5. Describe the importance of alarm fatigue in medical device connectivity.
6. Explore the challenges with medical device connectivity.

• KEY WORDS

Medical device connectivity
Interoperability
HL7
Middleware
MDDS
Device association
Data validation

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of medical devices? Why is important for nurses to know about the medical device industry? Are medical devices used only in the acute care setting? In what other environments would you find medical devices? Is interoperability important when discussing medical devices?

For a WIIFM statement, say to the class, this chapter discusses the medical device industry, which has experienced an explosion in the types and numbers of devices needed to care for patients. Traditionally, medical devices were concentrated to high acuity areas such as intensive cares, emergency departments, or surgical suites; however, much of the medical device surge is related to caring for patients outside the walls of high acuity areas and even outside the walls of the hospital. Device integration and connectivity is moving into the ambulatory and home care space where patients can be monitored with mobile technology. Advancements in wireless technology and mobile technology have implications not even considered yet. As a nurse, it is important to understand the medical device industry and its importance in healthcare.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Physiological Monitoring and Device Interface

1. In today's healthcare climate of increasing patient acuity, decreasing resources and increased financial restraints, the use of medical devices interfaced with each other as well as the electronic health record are imperative for the safety and quality of care of today's patient

2. Scenario
   a. *A patient is newly admitted to an intensive care unit from the emergency department at a suburban hospital. The patient is placed on a physiologic monitor and a ventilator in the ICU. The nurse associated the patient to the monitor so that she could automatically chart vital signs in the EHR. The patient has labs drawn and resulted every two hours via a POC (Point of Care) device. The patient had radiology exams in the ED prior to arriving in the ICU. An interactive infusion pump (Smart Pump) administers medications intravenously and interacts with the EHR to record titration of the medications automatically in real-time. Twenty-six miles away, at a remote monitoring center (tele-ICU) stationed in a large metropolis hospital is also monitoring the patient. An alarm sounds from the physiologic monitor at the bedside while a secondary alert sounds within the tele-ICU unit alerting staff at the patient's bedside as well as in the tele-ICU that the patient has gone into VT (Ventricular Tachycardia), a lethal heart arrhythmia that requires immediate intervention. While the care givers at the bedside start advanced cardiac life saving measures, the remote clinician can begin searching the EHR for the patients' most recent lab results, pertinent medical history, medication history as well as radiology results. The remote clinician has special software that enables the remote clinician to review real time vital signs, track and review trends and recognize changes. The remote clinician can view the activities occurring in the patient room via a two way camera with audio as well as call a code for the bedside thus allowing the bedside clinician to remain at the beside providing direct patient care. Together the bedside and remote clinicians methodically work together to resolve the issue, convert the patient and stabilize the patient ….*
   b. The aforementioned scenario is real and possible today due to advancements in medicine, technology, and legislation
      (1) According to Medical Strategic Planning, Inc., over the last decade the number of devices that need to be interfaced has grown from a handful to over 400 major devices
      (2) The medical device connectivity market was worth $3.5 billion in 2013 and is projected to reach $33 billion by 2019, which is a growth rate of 37.8 percent
      (3) Medical device connectivity is expected to increase efficiency and productivity, improve clinical workflow, lower costs while improving patient quality and safety

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Meaningful Use

1. Overview
   a. The Health Information Technology for Economic and Clinical Health (HITECH) Act signed into law on February 17, 2009 as part of the American Recovery and Reinvestment Act (ARRA) of 2009 stimulated adoption of the EHR
      (1) The HITECH Act allows eligible providers and eligible hospitals to qualify for the Center for Medicare Medicaid Services (CMS) incentive payments if they achieve "meaningful use" of certified EHR technology to provide patient care
      (2) The EHR vendors are incented to obtain ARRA certification for their EHR products. It is not enough for healthcare providers to have purchased and implemented a certified EHR, providers must also demonstrate meaningful use
      (3) The Centers for Medicare and Medicare Services (CMS) and the Office of the National Coordinator (ONC) for Health Information Technology are providing meaningful use criteria for both acute care (hospital/ER) and provider practices (clinic) settings
      (4) Eligible providers and eligible healthcare facilities that comply will receive incentive payments
      (5) In time, those failing to comply will be penalized
   b. Meaningful Use is a three-phased approach building upon each other. HITECH does not provide incentives specifically for medical device connectivity in itself, but connectivity drives the adoption of the EHR use and thereby meaningful user adoption

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Interoperability

1. Overview
   a. Medical device connectivity generally refers to the integration of medical devices with hospital information systems (HIS) to facilitate functions
      (1) Advancements in technology have expanded medical device connectivity from connecting a device to an EHR, to connecting disparate medical devices so that they all may communicate with each also known as **interoperability**
      (2) According to HIMSS, "interoperability describes the extent to which systems and devices can exchange data, and interpret that shared data. For two systems to be interoperable, they must be able to exchange data and subsequently present that data such that it can be understood by a user."

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Standardized Communication

1. Overview
   a. The ability of medical devices to talk to each other requires a standard language or communication structure, the most common in healthcare being HL7 or Health Level Seven

  - **(1)** According to Interface, HL7 is by definition an ANSI (American National Standards Institute) standard for healthcare specific data exchange between computer applications
  - **(2)** The name comes from 'Health Level 7,' which refers to the top layer (Level 7) of the Open Systems Interconnection (OSI) layer protocol for the health environment
  - **(3)** The HL7 standard is the most widely used messaging standard in the healthcare industry around the world

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Middleware

1. Overview

Device connectivity and operability require middleware

  - **(1)** **Middleware** is a term with broad implications
  - **(2)** For purposes of this chapter, **middleware** enables integration of data between two or more programs, devices, or information systems
  - **(3)** **Middleware** facilitates communication and data sharing
  - **(4)** While the following is not all-inclusive, several types of middleware will be discussed *such as integration engines, gateways, medical device data systems, and Class II medical devices for active monitoring*

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Integration Engine

1. Overview

- **a.** Often *integration engine* or *interface engine* are terms used interchangeably
  - **(1)** In the healthcare industry, integration engines use HL7 to characterize their ability to manage all interfaces
  - **(2)** The engines aggregate and share data regardless of the transmission protocol. They are responsible for message routing and translation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Gateway

1. Overview

- **a.** Data can also be transferred through a device *gateway*.
  - **(1)** These are usually through a central server that consolidates and collates data, then forwards the information to the aggregator or an EHR

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Medical Device Data Systems

1. Overview

- **a.** Unfortunately, not all medical devices use or know how to speak native HL7 so a medical device connectivity solution (MDCS) or a **medical device data system** (MDDS) is required

Teaching Tip
Refer to Table 28.1 which provides the FDA description of MDDS.

  - **(1)** MDCSs are available via the EHR vendor, medical device vendors, and third-party vendors
  - **(2)** Typically the EHR solution and medical device vendor solutions only work with its own solution whereas third party solutions are designed to be agnostic to the medical devices and can interface with a multitude of devices, sometimes referred to as *enterprise-wide connectivity*
  - **(3)** The advantage of third party vendors for a MDCS is it allows a single vendor to manage the interface between the enterprise-wide medical device data and the EHR rather than the facility managing a multitude of interfaces for each type of device
  - **(4)** It also enables hospitals to choose any vendor for patient care related devices regardless of the integration issues

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Class II Medical Devices

1. Overview

- **a.** According to FDA regulatory requirements in the healthcare information space, MDDS classified devices are limited to data transfers to an EHR only
  - **(1)** MDDSs are precluded from use in active patient monitoring and alarming
  - **(2)** While an MDDS can have alarms related to its own operational status it cannot analyze
  - **(3)** Solutions that collect, process, and distribute medical device data for surveillance, alarms, analytics, and decision support are not considered an MDDS but are regulated by the FDA as a Class II medical device
  - **(4)** A Class II medical device used for active monitoring is utilized in the aforementioned ICU scenario as the software that allows the remote clinicians to review real-time vital signs, track and review trends, and recognize changes

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Point of Care

1. Overview
    - a. The bedside medical device and how data is transmitted from the medical device characterizes the point of care (POC) connectivity solutions
        - (1) The POC solution serves as middleware where the POC device or component associates the patient to the medical device and compiles the information from the medical device to send to a server to be translated into an appropriate inbound language, generally HL7 for the EHR to accept and store. POC devices generally link to the medical device via a wired serial connection or wirelessly
        - (2) The association of the medical device data to a specific patient is generally referred to as *patient context* or *patient association*
        - (3) POCs contain *device drivers* that allow them to understand the proprietary data of the medical device POC

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Periodic/Episodic Devices

1. Overview

a. *Periodic* or *episodic devices* are those that obtain a single set of measurements from a patient at single points in time or spot checks

- (1) Episodic devices are generally mobile and used with multiple patients. Examples of common episodic devices are portable vital sign monitors, glucose meters, pulse oximetry, and EKG machines

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Continuous Networked Devices

1. Overview
    - a. Continuous devices are divided into stand-alone or networked devices
        - (1) Continuous networked devices are commonly stationed in a patient room to treat a single patient over a continuous time span
        - (2) They are generally hardwired and connected to a vendor specific central server negating the need for a POC component/Solution

Teaching Tip
Provide the example, an example is a bedside physiologic monitor such as the one in the aforementioned scenario.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Continuous Stand-Alone Devices

1. Overview
    - a. Continuous stand-alone medical device solutions are used to continuously monitor a single patient over a period of time, but the device is portable and not hardwired or networked to a vendor specific server, thereby requiring a POC component within the patient room or attached to the medical device itself
        - (1) In the scenario, the ventilator and infusion pump were continuous stand-alone devices

Teaching Tip
Refer to Table 28.2 which provides a diagram illustrating the medical device connectivity architecture.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Patient to Device Association (P2DA)

1. Overview
    - a. Consider the aforementioned scenario, the patient has multiple devices in the ICU, but how does the medical device and related POC solution know which patient the data is coming from in order to correctly translate it and direct it to the correct patient record in the EHR?
        - (1) The linking of the medical device data with the right patient is referred to as *patient association*
        - (2) There are historically two approaches to patient association; patient-centric and location centric

Teaching Tip
Refer to Table 28.3 which identifies common association terms.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Patient-Centric Identification

1. Overview
    - a. *Patient-centric identification* involves associating a medical device with a patient based on a unique patient ID number, often the patient's unique medical record number

(1) In our scenario the patient in the ICU is associated with the physiologic monitor

(2) The bedside nurse in our scenario manually entered the patient's unique ID number into the monitor when the patient was admitted which "associated" the right patient to the right device so the right data will be available for documentation

(3) Often the medical device may also have an ADT list to choose the correct patient

(4) The nurse in the scenario also associated the Smart Pump to the patient using bar code technology by scanning the patient's wristband and scanning the infusion pump so the patient is now associated to the pump

(5) Lastly, the nurse associated the ventilator

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Location Centric

1. Overview
   - **a.** In *location-centric* association the patient is typically identified by a location such as a room or bed
     - (1) This type of association can be unreliable and thereby unsafe, especially when a patient is moved often such as in an emergency department or surgical area
     - (2) In 2009 the Joint Commission added criteria to the NPSG.01.01.01 "Identifying Patients Correctly" goal that states "The patient's room number or physical location is not used as an identifier"
     - (3) With clear direction from the Joint Commission, coupled with the increasing meaningful use objectives most vendors and healthcare institutions are moving away from location centric association and identifying better means to support unique patient identifiers to provide safer patient to device communication

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Auto-ID

1. Overview
   - **a.** While our scenario focuses on a patient in an ICU where many devices are fixed or unique to critical care patients and continuous
     - (1) Imagine a typical medical/surgical acute care unit where vital sign monitors or blood glucose meters are used in multiple rooms on multiple patients for spot checks
     - (2) Manually entering a unique patient ID or selecting a patient from a list can be time intensive and allows room for error
     - (3) Auto-ID technologies such as bar code scanning and passive RFID is becoming increasingly useful and available as a means to assist with mobility and periodic device use

Teaching Tip
Refer to Table 28.4 which provides a more comprehensive overview of RFID from the FDA.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Data Validation

1. Overview
   - **a.** In the above scenario, the patient is associated to a monitor, and per the associated discussion we learned that the noise manually associated the monitor to the patient with the patient's unique identifier
     - (1) There is still a question as to how does the EHR know which vital signs to record or which vital signs are accurate?
     - (2) How does the EHR know not to record the blood pressure that was false because the cuff failed, or not to record the pulse oximetry reading of 75% that occurred when the pulse oximetry came off while the patient was turned?
     - (3) Since data is continuously being sent to the EHR, the nurse must validate which data is accurate and should be recorded within the permanent patient medical record
     - (4) This process of manual verification of data and recording it into the medical record is known as **data validation**
     - (5) The accuracy of the data is extremely important
     - (6) Data verification can occur at the POC component, within a separate application or within the EHR

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Connectivity Direction

1. Overview
   - **a.** Historically device connectivity solutions were unidirectional, or the flow of information was from the medical device to the EHR only; this is also often referred to as *classic* or *one-way connectivity*
     - (1) The emergence of bi-directional connectivity is mounting quickly as a viable solution in healthcare
     - (2) Bi-directional connectivity not only exports data from bedside medical devices to the EHR, but also allows the EHR to export data back to the bedside medical devices

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Smart Pumps

1. Overview
    - **a.** An emerging trend in acute healthcare settings is the use of *Smart Infusion Pumps* and *Interactive Smart Pumps*
        - **(1)** Smart pumps use drug libraries which allow infusion pumps to perform functions that assist with programming and calculating dose and rate delivery as adapted by a healthcare institution and to patient care areas
        - **(2)** Hard and soft limits or *guardrails* are programmed within Smart Pumps for medications
        - **(3)** Soft limits can generally be overridden after a clinician acknowledges a safety alert whereas hard limits are generally set for high-risk medications
        - **(4)** Smart Pumps may have software that allows the automatic transmission to the EHR
        - **(5)** Taking technology to the next level, a Smart Pump that has bi-directional communication is often referred to as an *Interactive Smart Pumps* and allows pre-populating the infusion orders from the EHR to the infusion pump, thus saving the nurses' time in programming the pump and reducing keying errors while programming ultimately increasing patient safety and efficiency
        - **(6)** Smart Pumps are not without complications and not intended to replace the human touch of a healthcare provider
        - **(7)** Smart pumps errors can be classified into user error or device error

Teaching Tip
Refer to Table 28.5 which lists common complications related to both classifications of errors.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Smart Rooms

1. Overview
    - **a.** Gaining traction is the growth of *Smart Rooms*
        - **(1)** The University of Pittsburgh Medical Center (UPMC) was the first to pilot such technology in a medical surgical unit (NurseZone) in June 2011
        - **(2)** The Smart Rooms at UPMC use real-time location solutions (RTLS) tracking to bring patient information from the EHR to a computer in the patient room
        - **(3)** The clinicians were identified when entering the room by ultra-sound enable badges identifying them to the patient and families eliminating the need for white boards
        - **(4)** Each patient room has a patient and family centered screen that can be used to identify caregivers, provide a schedule of the day's activities for the patient as well as access to view educational programs
        - **(5)** Lastly the rooms include a direct care touch screen which aids in documentation and provides important clinical attributes such as allergies, labs, and meds
    - **b.** As Smart Room technology has matured (grown) the desire for interaction and development has also grown
        - **(1)** From a clinical perspective, caregivers request more interfacing of devices including smart beds, single sign-on, RTLS that identifies where a patient is when off the unit or where a commonly used medical device is located such as an EKG machine
        - **(2)** Families have more concierge type requests such as entertainment (movies and games), electronic notepads, Web cams or video conferencing with patients from remote locations
        - **(3)** While Smart Rooms are in their infancy stages, as healthcare demands more interoperability and patients demand better safety and quality service the use of Smart Room technology will continue to mature

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Alarms

1. Overview
    - **a.** Alarms are intended to alert a caregiver when an immediate or potentially adverse event occurs or could occur
        - **(1)** A caregiver is then expected to acknowledge the alarm and respond appropriately. As the number of medical devices increases, so has the number of alarms generated from medical devices
        - **(2)** Caregivers are challenged with responding to multiple alarms produced from multiple devices
        - **(3)** Considering our scenario of the patient in the ICU, alarms could be emitted not only from the physiologic monitor, infusion pump and ventilators, but the nurse must also respond to call lights, bed-exit devices, feeding pumps, sequential compression devices, telephone calls, texts/pages, etc.
    - **b.** According to the Joint Commission, there may be several hundreds of alarms per day per patient depending on the patient's location
        - **(1)** Many alarms are false alerts or nuisance alarms
        - **(2)** A nuisance alarm does not usually indicate immediate intervention is needed. An example could be that a patient's physiologic monitor alerts because the patient turned in the bed and there was a jump in the patient's heart rate while the patient turned
        - **(3)** It is estimated that 85 to 99 percent of alarms do not require intervention

2. Alarm fatigue
   a. Due to the aforementioned issues, many caregivers become immune or desensitized to the alarms and are not as timely to respond to alarms
      (1) In some scenarios, the alarms may be intentionally and unintentionally silenced or turned off
      (2) Either desensitization or silencing alarms lead to patient harm
3. Use alarms safely
   a. The Joint Commission has taken a position in deterring patient harm due to alarm errors and has added alarms back into the 2014 National Patient Safety Goals, NPSG.06.01.01
      (1) Use Alarms Safety, requiring improvements to ensure that alarms from medical devices are heard and responded to timely
      (2) While much of the ownership of alarm fatigue and adverse events related to alarms is placed on the caregivers and healthcare institutions, medical device companies are exploring technology to develop safer and more effective alarm management
      (3) Medical device vendors are seeking to improve parameter acquisition techniques as well as improve alarm and alert designs to reduce non-clinically significant alarms
      (4) Medical device vendors are researching and implementing *smart alarms, which* are alarms that are built upon algorithms that consider multiple physiologic parameters
      (5) Lastly, efforts are being created around middleware that could route alarms from various devices to central call systems either location-based or through a mobile nurse call system

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Challenges

1. Overview
   a. While there have been huge advancements in medical device integration, there are just as many challenges that still need to be addressed as the industry matures
2. Cost
   a. From a vendor standpoint, it is timely and costly to research and develop devices, device drivers, and software
   b. Once the software or devices are available on the market, it is expensive for healthcare facilities to replace or purchase new equipment
   c. It can also be very time consuming to test and install updated software
   d. From a structural standpoint, it can be very costly to add network components after a structure is constructed so as healthcare facilities expand or rebuild, infrastructure of existing network as well as the future of networks need to be considered
3. Risk Management/Security
   a. Healthcare institution information systems transmit and store a great deal of sensitive and protected information therefore mitigating risks; and safely securing the information is as important as safely caring for the patient
   b. However, medical IT and device interoperability industry lacks mature communication standards and governance
   c. While the FDA regulates the classification of medical devices, there is room for growth in how the devices interface and communicate

Teaching Tip
Refer to Table 28.6 which lists some of the Healthcare IT advocacy associations and standards.

4. Clinician Adoption
   a. Device vendors and healthcare providers must work together to continue development of automation that will enhance patient care, safety, and workflows
   b. When new types of technology or devices are introduced in the healthcare setting, it must increase efficiency or adoption will not occur
   c. Typically, there is not a one-size-fits-all approach because workflows vary immensely between settings and units
   d. Workflows and challenges with workflows must be thoroughly considered and tested prior to implementation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY/CONCLUSION

- Over the last decade, the medical device industry has experienced an explosion in the types and numbers of devices needed to care for patients
- Traditionally, medical devices were concentrated to high acuity areas such as intensive cares, emergency departments, or surgical suites; however, much of the medical device surge is related to caring for patients outside the walls of high acuity areas and even outside the walls of the hospital
- Device integration and connectivity is moving into the ambulatory and home care space where patients can be monitored with mobile technology
- Advancements in wireless technology and mobile technology has implications not even considered yet

Teaching Tip

Scenario Revisited

The patient recovered from her life-threatening arrhythmic event and is ready for discharge from the hospital. Due to having a life threatening cardiac event, she will be discharged with a wireless home holter monitor and pulse oximetry. A visiting nurse will visit and download the information from the holter monitor and oximetry weekly. In the meantime, the patient will record all her activity, rest and recovery.

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe the importance of medical device connectivity
- Define components of medical device interface devices
- Understand issues and challenges of infusion management and Smart Pumps
- Introduce Smart Room technology
- Describe the importance of alarm fatigue in medical device connectivity
- Explore the challenges with medical device connectivity

Teaching Tip
Ask the students to define the keywords

- Medical device connectivity
- Interoperability
- HL7
- Middleware
- MDDS
- Device association
- Data validation

CHAPTER REVIEW QUESTIONS

Question 28.1: Name three types of physiologic monitoring devices.

a. Infusion pumps, blood pressure monitors, fetal monitors
b. CPOE, EHR, HIS
c. a and b
d. None of the above

Question 28.2: True or False. The extension of physiologic monitoring devices to home care and mobile devices is occurring.

Question 28.3: What are three challenges that still need to be addressed in medical device integration?

a. Cost, risk management security, and clinician adoption
b. Alarm fatigue, usability, and workflow
c. Ability to link devices to devices, ability to link to an EHR, ability to link to HIS
d. Lack of standards sufficient to link devices

Question 28.4: Smart Pumps technology is defined as ______________?

a. Smart pumps use drug libraries which allow infusion pumps to perform functions that assist with programming and calculating dose and rate delivery as adapted by a healthcare institution and to patient care areas
b. Smart pumps use devices that can automatically monitor and manage the drugs given to patients
c. Smart pumps use devices that can automatically infuse medications to patients
d. None of the above

Question 28.5: What is the importance of Alarm Fatigue in medical device connectivity?

a. Caregivers become immune or desensitized to the alarms and are not as timely to respond to alarms
b. Alarms may be intentionally and unintentionally silenced or turned off
c. Both a and b result in patient harm.
d. All of the above

Question 28.6: The linking of the medical device data with the right patient is referred to as _______________.

a. The linking of the medical device data with the right patient is referred to as patient association
b. The linking of the medical device data with the right patient is referred to as Point of Care
c. The linking of the medical device data with the right patient is referred to as patient order entry
d. The linking of the medical device data with the right patient is referred to as patient access

Question 28.7: What does Patient-Centric Identification involve?

a. The linking of the medical device with the right patient
b. Associating a medical device with a patient based on a unique patient ID number, often the patient's unique medical record number
c. Associating the medical device with the patients CPOE
d. Associating the medical device with the consumer manufacturing code for safety

Question 28.8: In what areas is the impact of medical device connectivity expected?

a. Medical device connectivity is expected to increase efficiency and productivity, improve clinical workflow, lower costs while improving patient quality and safety
b. Medical device connectivity is expected to increase medication management, translation to providers, and better understanding of healthcare by consumers
c. Medical device connectivity is expected to increase the use of the EHR, standardized care, and the ability of the nurse to lower costs
d. Medical device connectivity is expected to increase clinical workflow only

Question 28.9: What does Interoperability of medical devices refer to?

a. The integration of medical devices with hospital information systems (HIS) only
b. The integration of medical devices with EHRs only

c. The integration of disparate medical devices with each other and HIS and EHR

d. None of the above

Question 28.10: What US Standard provides medical devices the ability to talk with each other?

a. Any of the approved ANA certified nursing terminologies will provide medical devices the ability to talk with each other

b. Any of the approved International Classification of Disease (ICD) codes will provide medical devices the ability to talk with each other

c. HL7 is the standard that provides medical devices the ability to talk with each other

d. The Clinical Decision Support (CDSS) is the standard that provides the medical devices the ability to talk with each other

ANSWERS AND EXPLANATIONS

Question 28.1: (a) Infusion pumps, blood pressure monitors, fetal monitors.

Question 28.2: True. The extension of physiologic monitoring devices to home care and mobile devices is occurring.

Question 28.3: (a) Cost, risk management security, and clinician adoption.

Question 28.4: (a) Smart pumps use drug libraries which allow infusion pumps to perform functions that assist with programming and calculating dose and rate delivery as adapted by a healthcare institution and to patient care areas.

Question 28.5: (d) All of the above. Caregivers become immune or desensitized to the alarms and are not as timely to respond to alarms, Alarms may be intentionally and unintentionally silenced or turned off, and either may result in patient harm.

Question 28.6: (a) The linking of the medical device data with the right patient is referred to as patient association.

Question 28.7: (b) Associating a medical device with a patient based on a unique patient ID number, often the patient's unique medical record number.

Question 28.8: (a) Medical device connectivity is expected to increase efficiency and productivity, improve clinical workflow, lower costs while improving patient quality and safety.

Question 28.9: (c) The integration of disparate medical devices with each other and HIS and EHR.

Question 28.10: (c) HL7 is the standard that provides medical devices the ability to talk with each other.

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29

Health Information Technology: Striving to Improve Patient Safety

• OBJECTIVES

1. Describe the current state of the evidence in relation to health IT and patient safety.
2. Discuss the federal government's involvement in assisting to improve patient safety using health IT.
3. Describe at least three resources that organizations can use to evaluate the safety of their IT systems..

• KEY WORDS

Health IT
Patient safety
Errors
Electronic Health Record (EHR)
Computerized Provider Order Entry (CPOE)
Unintended consequences
HITECH Act
Office of the National Coordinator for Health IT (ONC)
Patient safety organizations
Common formats

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of patient safety organizations (PSOs)? What is the role of health information technology in patient safety? Can you give examples where health information technology improved patient safety? Is patient safety a priority in healthcare? Can you give examples demonstrating patient safety is a priority in healthcare?

For a WIIFM statement, say to the class, "this chapter will provide background information in the area of health IT and patient safety as it has evolved over the last decade. It will review the government's response in addressing the health IT safety issue. Involvement by other professional organizations will be briefly reviewed, followed by an offering of tools and resources that organizations can utilize in their practice settings to assist in ensuring that health IT is as safe as possible." As a nurse, it is important to understand patient safety initiatives and organizations, as well as the role of health information technology in improving patient safety.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
   - **a.** The first Electronic Health Record (EHR) with Computerized Provider Order Entry (CPOE) was introduced in 1971, over 40 years ago
     - **(1)** Since then, adoption of these systems in both acute and ambulatory settings has been relatively slow, until the signing of the American Reinvestment and Recovery Act (ARRA) in 2009
     - **(2)** The ARRA included the authorization of the Health Information Technology for Economic and Clinical Health (HITECH) Act, which allocated over $17 billion to stimulate the adoption of quality health IT systems or EHRs that demonstrate meaningful use
   - **b.** While these financial incentives to increase adoption appear to be working, issues from rapid implementation have surfaced over the last decade including several related to patient safety
     - **(1)** As these systems have evolved and increased in sophistication, evidence supporting the view that EHRs reduce medication errors has been documented
     - **(2)** On the other hand, conflicting studies have provided evidence that these systems can actually increase errors, attributing them to poor design or implementation
     - **(3)** The recent focus has been on the adoption of EHRs to achieve incentive payments from the HITECH Act, with less of a focus on patient safety
     - **(4)** The HIT industry, the federal government and other watchdog agencies have begun to take notice
     - **(5)** This chapter will provide background information in the area of health IT and patient safety as it has evolved over the last decade
     - **(6)** It will review the government's response in addressing the health IT safety issue
     - **(7)** Involvement by other professional organizations will be briefly reviewed, followed by an offering of tools and resources that organizations can utilize in their practice settings to assist in ensuring that health IT is as safe as possible

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Background—Health IT Safety

1. **Overview**
   - **a** Since its publication in 1999, the Institute of Medicine's *To Err is Human* has been a driving force for improvements in patient safety across the nation
     - **(1)** The evidence cited clearly indicates the seriousness of the situation in terms of lives lost and money wasted as a result of errors that occur in our healthcare organizations
     - **(2)** There have been multiple solutions offered, but a common and resounding theme continues to be the use of technology and the application of EHRs with CPOE systems
     - **(3)** Literature supporting the use of electronic records to reduce errors has been evolving and includes several systematic reviews as well as stand-alone studies
     - **(4)** Evidence demonstrates that they really can reduce errors
     - **(5)** This positive outlook has driven healthcare's key stakeholders to proceed with development, adoption and oversight, including EHR vendors, hospitals, ambulatory practices, home health agencies, long term care facilities, and the federal government
     - **(6)** With the signing of the ARRA in 2009organizations became increasingly eager to adopt EHRs and receive sizeable incentive payments
     - **(7)** In fact, hospital adoption of at least a basic EHR system has more than tripled since 2009, with a concomitant increase in the total percentage of hospitals with certified EHRs from 72 to 85 percent
     - **(8)** Additionally, in 2012, nearly three-quarters (72 percent) of office-based physicians adopted an EHR, up from 42 percent in 2008
   - **b.** While the studies mentioned above support the benefits and enhanced safety features that can be realized with an EHR, along with a CPOE system, there have been articles published that indicate a potential negative side, one that points to the EHR as the actual cause of errors
     - **(1)** A popular study that was published in the *Journal of the American Medical Association* by Koppel et al. in 2005 reported that CPOE systems actually facilitate medication errors
     - **(2)** This article ran contrary to what most believed, but identified, using quantitative and qualitative methods, 22 types of medication error risks associated with the use of CPOE
     - **(3)** In a retrospective study by Walsh et al. (2006), researchers attempted to determine the frequency and types of pediatric medication errors attributable to design features in a CPOE system
     - **(4)** The rate of identified computer related errors was 10 errors per 1000 patient days, and the rate of "serious" computer related errors was 3.6 errors per 1000 patient days
     - **(5)** Another study highlights how an EHR perpetuated a deadly IV order of potassium that was left unchecked
     - **(6)** In this case study, a patient received a total of 316 mEq of KCL over 42 hours despite the fact that all KCL orders during that time period were entered via a CPOE system
     - **(7)** And in a study by Han et al. (2005) researchers observed an unexpected increase in mortality in a pediatric ICU that coincided with the implementation of their CPOE system
   - **c.** In a qualitative study by Campbell, Sittig, Ash, Guappone and Dykstra (2006), researchers attempted to identify the types of unintended consequences seen with the implementation of EHR systems with CPOE

    - **(1)** This study involved an expert panel using an iterative process that took a list of adverse consequences of CPOE, and sorted them into categories
    - **(2)** One category labeled "Generation of New Kinds of Errors" indicated that new kinds of errors appear when CPOE is implemented
    - **(3)** Examples of items in this category include
        - **i.** Juxtaposition errors when users select an item next to the intended choice
        - **ii.** A wrong patient being selected
        - **iii.** Desensitization to alerts (alert overload)
        - **iv.** Confusing order option presentations
        - **v.** And system design issues with poor data organization and display
    - **(4)** Users get frustrated trying to find the right spot to enter a particular data element and end up entering orders on generic screens, bypassing any rules and alerts configured; all potentially leading to medication errors
    - **(5)** While all of these studies, both positive and negative, provide valuable insight into how EHRs are configured, each one of them report limitations with the studies and admit that it would be difficult to generalize the findings

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

National Health IT Safety Initiatives

1. Institute of Medicine—Health IT and Patient Safety Report
    - **a.** Recognizing the need to increase focus on implementing EHRs safely, the Office of the National Coordinator for Health Information Technology (ONC) requested that the Institute of Medicine (IOM) form a team of experts to assess the current state of EHRs and their ability to improve patient safety
        - **(1)** In November 2011 the IOM published "Health IT and Patient Safety: Building Safer Systems for Better Care"
        - **(2)** This 235 page document provides a comprehensive description of the state of EHRs and their ability to improve safety with a goal of making health IT-assisted care safer, putting our nation in the best position to realize the potential benefits of health IT

Teaching Tip
Refer to Table 29.1 which provides the 10 recommendations.

    - **b.** After their review and analysis, the IOM panel of experts found little published evidence to quantify the magnitude of the risk, but believe that if designed and implemented inappropriately, EHRs could lead to unintended adverse consequences
        - **(1)** They reported that the literature on the topic was limited and lacked what was needed to truly define and assess the current situation of health IT safety
        - **(2)** They recognized the current dissatisfaction with poor user interface design, poor workflow support, and complex data interfaces as being threats to patient safety
        - **(3)** Also identified as a contributing factor to unsafe conditions was the lack of system interoperability and the need for clinicians to review data from multiple systems
    - **c.** It is clear in this report that the need to develop strategies that will standardized the reporting of health IT-related errors is needed
        - **(1)** The depth and breadth of the problem cannot be measured or analyzed when error reporting structures are heterogeneous, not mandated and often swept under the carpet
        - **(2)** There is also an emphasis on increasing the transparency in that reporting from both vendors and system users as the industry learns and improves
        - **(3)** It points out the need for a multifaceted approach and calls for vendor participation, IT user involvement and governmental support and oversight
        - **(4)** Safer implementation and use of health IT is a complex, dynamic process that requires a shared responsibility between vendors and healthcare organizations
        - **(5)** The importance of this work was evident in one of the IOM recommendations which requested the development of an action plan by the ONC within 12 months to ensure that improvements proceed in a strategic way
2. Office of the National Coordinator for Health Information Technology—Safety Plan
    - **a.** In July of 2013, ONC published their response to the IOM report in the form of the Health Information Technology Patient Safety and Action and Surveillance Plan
        - **(1)** They iterate the challenge of discerning if health IT is the true cause of a medical error given the limitations on the recent research
        - **(2)** There are many unknowns and the need to clearly define health IT-related errors of both omission and commission is still needed

Teaching Tip
For example, if allergy alerting in an EHR has not been configured or turned on, and a patient experiences an adverse allergy event—is that a health IT-related error? What about when a system user opens a patient list for an inpatient unit and the patient at the top of the list is already preselected by default. If orders are accidently placed on this patient—is that a health IT-related error? Many errors such as these have been identified, while many others are still lurking, yet to be recognized when a near miss or adverse event occurs. With this in mind, the ONC action and surveillance plan that address the need to focus on learning and assessing the current status prior to developing the solution. It calls for strong leadership at all levels to continue to take on the task of realizing the potential of these systems that can improve patient safety with a goal of inspiring confidence and trust in health IT.

    - **b.** The ONC's Action and Surveillance plan has two main objectives, (1) Use health IT to make care safer and (2) Continuously improve the safety of health IT

   - **(1)** They emphasize the importance of a shared responsibility between clinicians, administrators, IT staff, quality improvement staff, patients, government, health IT vendors, usability experts, patient safety organizations (PSOs), accrediting bodies, academic institutions, health insurers, professional organizations, and publishers
   - **(2)** It will truly take all of these key stakeholders working together to ensure health IT is used as safely as possible and is optimized to reduce errors
- **c.** The plan revolves around three key areas: Learning, Improving, and Leading
   - **(1)** Recognizing the fact that there is much to learn in this area, the ONC is aiming to increase the quantity and quality of data and knowledge about health IT safety
   - **(2)** While organizations may internally discover, report, and correct health IT-related errors, there lacks a standard methodology for reporting that will benefit patients at large
   - **(3)** The establishment of processes and mechanisms that facilitate reporting among users and vendors of health IT is recommended along with strengthening the use of state and national PSOs to help collect and report on these issues
   - **(4)** Additionally, the need is recognized that not only do we need standard terminologies to report health IT-related errors, but we need processes to report them centrally and a method to aggregate and analyze the data
   - **(5)** The goal is to make it easy for clinicians to report patient safety events to PSOs using standard terminologies such as the Agency for Healthcare Research and Quality's (AHRQ) Common Formats. AHRQ develops and maintains a set of Common Formats that include a set of common definitions and reporting formats that allow organizations to collect and submit standardized information regarding health IT-related patient safety events and hazards
   - **(6)** The ONC proposes to support PSOs in their work to collect, aggregate, and analyze the data related to health IT safety
   - **(7)** On a broader scale, ONC will continue their work in support of the National Quality Strategy (NQS) to identify opportunities to learn and ultimately make care safer through the use of health IT
- **d.** In addition to growing the body of knowledge related to health IT and patient safety, the ONC plans to focus on improvement efforts
   - **(1)** The goal is to develop resources and evidence-based corrective actions to improve health IT safety and patient safety
   - **(2)** To establish priorities in health IT safety work, the ONC intends to align with the NQS, the Meaningful Use program as part of the HITECH Act, and the Centers for Medicare and Medicaid Service's (CMS) Partnership for Patients initiative.
   - **(3)** Through goals established by the NQS, an emphasis is recommended in areas such as strategies for how technology can assist in the reduction of hospital readmissions and preventable hospital-acquired conditions
   - **(4)** Supporting these goals are the 10 patient safety domains set forth by CMS's Partnership for Patients
   - **(5)** These domains include
      - **i.** Adverse drug events
      - **ii.** Catheter associated urinary tract infections
      - **iii.** Central line associated blood stream infections
      - **iv.** Readmissions
      - **v.** Ventilator associated pneumonia
      - **vi.** Pressure ulcers
      - **vii.** Surgical line infections
      - **viii.** Obstetrical adverse events
      - **ix.** Venous thromboembolism
      - **x.** Injuries from falls and immobility
   - **(6)** Utilizing health IT to improve in these areas will help drive the patient safety effort
   - **(7)** The plan additionally intends to continue the work of the Meaningful Use program that supports and encourages safe and meaningful use of health IT
   - **(8)** This effort includes configuring EHRs with CPOE to reduce medication errors using allergy alerting, dose range checking, improving reconciliation of medications across care settings, and many other methods to assist in error reduction
- **e.** Other improvement efforts considered important and included in the plan address the need to incorporate safety into certification criteria for health IT software as well as into education and training on the safe use of health IT for all healthcare professionals
   - **(1)** The need to support health IT research and the development of tools is also emphasized
   - **(2)** ONC has begun work in this area by contracting with research teams to develop tools that can be used by organizations that use these systems as well as vendors who produce them
   - **(3)** Some of these tools will be described later in this chapter
- **f.** Driving safety improvements requires leadership and the ONC spells out a number of strategies to address the direction that needs to be supported
   - **(1)** In addition to providing methods to engage all key stakeholders, ONC is planning to develop a strategy and recommend an appropriate, risk-based regulatory framework for health IT
   - **(2)** This framework includes working collaboratively with other federal agencies such as the Food and Drug Administration and the Federal Communications Commission
- **g.** Encouraging state governments to get involved and incorporate health IT into their patient safety oversight program is included in this plan with an emphasis on statewide adverse event reporting
   - **(1)** Including the patient and family caregivers as part of the solution is listed as a focus that ONC will address in order to more effectively engage patients in using health IT to make care safer
   - **(2)** And lastly as part of leading this effort, the ONC will establish a Safety Program that coordinates these efforts among all stakeholders to ensure cohesive progress is being made as the plan is implemented

    (3) Through efforts coordinated by ONC, The Department of Health and Human Services (HHS) will monitor the Health IT Safety Program and strive toward the goal of patients and providers having confidence in the safety of health IT

3. Agency for Healthcare Research and Quality—Common Formats
    a. In addition to the many areas of healthcare that AHRQ participates, they have taken a significant interest in the area of health IT over the last several years in partnership with the ONC
        (1) One area of focus has been the development of what are called Common Formats for reporting patient safety events
        (2) Their vision, along with the ONC is that the reporting of health IT safety issues will occur not just at the organizational level, but at the national level as well
        (3) In using the Common Formats for reporting, it is hoped that standardized aggregate data will provide valuable analysis and trending that can lead to more focused efforts and significant improvements in patient safety
        (4) To assist in this effort many states have now formed PSOs that have emerged as part of the Patient Safety and Quality Improvement Act of 2005
        (5) At present there are 77 PSOs in 29 states listed by AHRQ
        (6) It is these organizations that will help in the collection of data on patient safety and submit nonidentified data to AHRQ's Network of Patient Safety Databases (NPSD)
        (7) In addition to the PSOs, providers and other entities can voluntarily contribute nonidentified patient safety events to the NPSD
    b. The Common Formats for standardized reporting of health IT-related errors are actually not found on AHRQ's Web site, but on the PSO Privacy Protection Center's Web site, and are a bit challenging to find
        (1) Descriptions and contributing factors for health IT safety issues are listed and can be used when reporting incidents, near misses and unsafe conditions

Teaching Tip

Provide the following example, a "4.3 Contributing Factor" of an incident may be related to "4.3.2 Equipment/device function" that resulted in "4.3.2.1 Loss or delay of data." As software evolves to more efficiently capture health IT safety events, it is hoped that Common Formats will be utilized as the norm to aid in our learning as we continue to improve our clinical systems.

    c. In 2011, AHRQ announced the completion of another tool called the Health IT Hazard Manager after extensive beta testing, which gives healthcare providers a method of capturing and managing hazard data in software that includes near miss errors and actual errors, according to the AHRQ Web site
        (1) The AHRQ tool, funded with a $750,000 grant led by Abt Associates with the ECRI Institute and Geisinger Health System's Patient Safety Institute, doesn't allow healthcare providers to share data collected with the tool among themselves, but to see only their own reports
        (2) Vendors, however, will receive the safety reports relevant to their products
        (3) According to AHRQ, healthcare organizations, vendors, policymakers, and researchers will be able to request access to view de-identified, aggregate reports of hazard attributes
        (4) The terms used in the Hazard Managers are mapped to those in the Common Formats so data can be aggregated and analyzed
        (5) While the Hazard Manager tool itself has not yet been released, the research surrounding its development is available for those interested in health IT safety and its reporting

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. Food and Drug Administration
    a. While the US Food and Drug Administration (FDA) has been concerned with patient safety since its inception, they have only recently explored the area of EHRs
        (1) For decades, the FDA has received several hundred thousand medical device reports (MDRs) of suspected device-associated deaths, injuries, or system malfunctioning
        (2) These MDRs have been entered into the Manufacturer and User Facility Device Experience or MAUDE database for centralized housing, analysis and reporting
        (3) A limitation of this database is its age
        (4) Because it's so old, its capabilities to conduct real-time reporting and analysis is limited, hindering any attempts to discover unknown adverse events
        (5) This, in turn, affects its ability to generate and evaluate evidence
        (6) A new database will soon take its place according to a press release statement from September 17, 2013 called the Pharmacovigilance Report Intake and Managed Output (PRIMO) software system
    b. In July of 2012, Congress enacted the Food and Drug Administration Safety and Innovation Act (FDASIA)
        (1) Section 618 of FDASIA instructs the Secretary of HHS, acting through the FDA Commissioner and in collaboration with ONC and the Federal Communications Commission (FCC) to issue a report by January 2014 on a proposed strategy that includes recommendations on an appropriate risk-based regulatory framework for health IT
        (2) The intent is for the framework to promote innovation, protect patient safety, and avoid regulatory duplication
        (3) The report will be informed by input from the public as well as the ONCs Health IT Policy Committee and will incorporate what the agencies learn about risk, safety, and opportunity for innovative technologies to support improved health and safety outcomes
        (4) The agencies will consider how to make it easier for innovators to understand the regulatory landscape, ways to minimize regulatory burden and how to design an oversight approach that supports innovations and patient safety

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. The Institute for Safe Medication Practices
  a. The Institute for Safe Medication Practices (ISMP) is devoted entirely to medication error prevention and safe medication use
    (1) They have been in existence for over 30 years, helping healthcare practitioners keep patients safe
    (2) Their mission is to lead efforts to improve the medication use process
    (3) They have published multiple guidelines and tips for the designers of EHRs as they configure medication orders and order sets
    (4) The ISMP's Guidelines for Standard Order Sets provides a five page checklist that allows organizations to evaluate the safety of their CPOE systems
    (5) This guide includes recommendations for screen layout, use of symbols and abbreviations and order set content development
    (6) ISMP also has a robust voluntary error-reporting program called the Medication Errors Reporting Program (MERP)
    (7) This is a system where practitioners can report any errors related to medication use
    (8) The goal for this program is to learn about errors occurring nationwide, understand their origins, and share lessons learned with the healthcare and health IT community
    (9) Each year, ISMP receives hundreds of error reports from healthcare professionals. Additionally, ISMP is certified as a Patient Safety Organization (PSO) by AHRQ

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

6. ECRI Institute
  a. For 45 years, ECRI Institute, a nonprofit organization, has focused on scientific research to discover the effectiveness of medical procedures, devices, drugs, and processes, all to improve patient care. ECRI Institute is also a PSO; in fact it's one of the first to be federally certified
    (1) In December of 2012, they conducted an evaluation of health IT-related events and unsafe conditions with the goal of improving the understanding of technology's impact on healthcare delivery
    (2) In this publication "ECRI Institute PSO's Deep Dive: Health Information Technology" included more than 170 health IT-related events reported by 36 healthcare organizations over a nine-week period
    (3) The events included wrong patient data entries, users ignoring alerts, and gaps in reporting critical test results due to poor system interoperability
    (4) Some events involved multiple safety issues and in total identified 211 patient safety issues that were grouped into 22 event categories
    (5) The five most frequently identified health IT-related problems identified were
      i. System interface issues
      ii. Wrong input
      iii. Software issue/system configuration
      iv. Wrong record retrieved
      v. And software issue/functionality
    (6) This report was followed by a whitepaper titled "Anticipating Unintended Consequences of Health Information Technology and Health Information Exchange: How to Identify and Address Unsafe Conditions Associated with Health IT"
    (7) In this report several examples of commonly encountered health IT-related incidents are shared

Teaching Tip
Provide the examples, the user ignored or overrode an alert; test results were sent to the wrong provider causing a delay in action; text entries were not shared due to poorly designed interfaces between systems; and an item from an outside source was scanned into the wrong patient record.

    (8) It further explores these phenomena of health IT and patient safety, but strongly advocates for using standardized reporting methods that funnel up to PSOs
    (9) Issues to be addressed by healthcare managers are listed that provide a foundation for a solid health IT safety program
    (10) These issues include a checklist of questions a manager should ask as health IT safety is evaluated
    (11) Questions include topics of
      i. How adverse events are reported
      ii. If a standard terminology is used in the reporting
      iii. What processes are in place to follow up after an incident
      iv. Policies/procedures in place for system corrective action, and the existence of a budget to support health IT safety activities

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

7. Leapfrog Group
  a. Another CPOE opinion leader, The Leapfrog Group, represents a coalition of healthcare purchasers that has been a driving force in the improvement of healthcare quality
    (1) They are strong advocates for the use of CPOE systems
    (2) They have developed a CPOE "standard" including a requirement that organizations operating CPOE systems should demonstrate (via testing scenarios) to ensure that their inpatient CPOE system can alert physicians to at least 50 percent of common serious prescribing errors

- **(3)** In an article by Kilbridge, Welebob and Classen (2006), the development of these standards are described, including the description of a framework with 12 different categories of CPOE-based decision support that have the potential to prevent a prescribing error
- **(4)** Organizations are asked to conduct this test in a development or practice database that is similar to their production CPOE system
- **(5)** Configuration elements of the system that are tested include
  - **i.** Duplicate ordering
  - **ii.** Single- and cumulative-dose levels
  - **iii.** Allergy checking
  - **iv.** Drug-drug interaction
  - **v.** Contraindications based on patient diagnosis
  - **vi.** Contraindications based on relevant laboratory values and dose levels based on radiology studies
- **(6)** This test is Web-based and self-administered, but can only be taken if the organization also participates in Leapfrog's general hospital survey

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Health IT Safety Tools and Resources

1. Overview
- **a.** Resources for organizations to turn to for help with not only developing health IT safety strategic plans, but for assessing their current situation have been emerging over the last several years
  - **(1)** These tools provide excellent information for those in charge of health IT safety with varying levels of expertise
  - **(2)** Tools include the Web-based Guide to Reducing Unintended Consequences in Health Information Technology, the Safety Assurance Factors for EHR Resilience (SAFER) Guides, ECRI Institute's "How to Identify and Address Unsafe Conditions Associated with Health IT, The CPOE Design Recommendations Checklist, and the Pick-list Checklist

2 AHRQ's Guide to Reducing Unintended Consequences of Electronic Health Records
- **a.** AHRQ's Guide to Reducing Unintended Consequences of Electronic Health Records is an online resource designed to help organizations anticipate, avoid, and address problems that can occur when implementing and using an EHR
  - **(1)** The purpose in developing the Guide was to provide practical knowledge, troubleshooting tools and resources
  - **(2)** The guide provides multiple resources and addresses both future and current EHR users
  - **(3)** It provides information on how to survive a system downtime and includes a copy and paste toolkit as organizations struggle to address the complexities of allowing this functionality in EHRs
  - **(4)** Case examples are provided on safety related topics along with potential remediation solutions to several challenges in health IT

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. SAFER guides
- **a.** The SAFER guides consist of nine guides organized into three categories. These guides enable healthcare organizations to conduct self-assessments of their EHR safety in a variety of areas
  - **(1)** The guides identify recommended practices to optimize the safety and safe use of EHR
  - **(2)** Each guideline contains a listing of recommended practices

Teaching Tip
See Table 29.2 for the categories and high level descriptions of the nine recommendation guides

  - **(3)** These recommended practices are then broken down further into associated rationale, suggested sources of input for reviewing the practice, and examples of potentially useful practices or scenarios
  - **(4)** An emphasis is placed on the need to review and analyze these recommendations with all key stakeholders at the table
  - **(5)** A multidisciplinary approach with IT staff, clinicians, risk managers, administrators and other appropriate team members, all at the table is believed to be ideal for the success of working through these guides

4. CPOE Design Checklist/Pick-list Checklist
- **a.** Two additional checklists that address health IT safety and provide tools for evaluating a current EHR include the CPOE Design Checklist and the Pick-list Checklist
  - **(1)** These tools include checklists for configuring a CPOE system and creating Pick lists, or drop down lists that are based on published health IT safety evidence
  - **(2)** The CPOE Design Checklist is a 46-item list and provides a tool that can be used during software selection, design, or evaluation
  - **(3)** The items in the list fall into four categories: Clinical Decision Support, Order Form Configuration, Human Factors Configuration, and Workflow Process Configuration

Teaching Tip
Provide examples, some of the checklist items included in the CPOE Design Checklist are found in Table 29.3.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. The Pick-list Checklist
   - **a.** In the 2011 IOM report, Health IT and Patient Safety: Building Safer Systems for Better Care, one of the ten recommendations mentioned earlier emphasizes the need to conduct more research in the area of health information technology and patient safety
     - **(1)** They specifically state that there should be more research in the area of "the pick-list problem"
     - **(2)** A review of the literature finds relatively little information on how to properly configure a pick list in an EHR, and no research studies have been conducted to date on the pick list itself
     - **(3)** The limited information gleaned in the literature is offered in an 11 item Pick-list Checklist that can be used by all levels of informatics specialists to assess the current configuration based on the best evidence available
     - **(4)** An easy to use checklist such as this has multiple benefits and represents a starting point for informatics specialists to evaluate and improve the systems that care providers rely on to deliver safe patient care
     - **(5)** Examples of items contained within this checklist include:
       - **i.** Not truncating items on the pick list
       - **ii.** Do not put similar terms on top of one another
       - **iii.** Do not by default pre-select an item on the list
       - **iv.** And use alternating line colors between patient names to help in the visual separation of names
     - **(6)** We need to configure our systems so that our users choose the right thing the first time
     - **(7)** Each of the items listed in the Pick-list Checklist do not seem to be rocket science, but taken collectively, they have the potential to strengthen the quality and safety that clinical systems were meant to deliver

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- Think nationally, act locally
- This is a mantra we should adopt when it comes to health IT
- Our federal government and professional organizations can only do so much
- It will take each organization working in partnership with the government, health IT vendors, and PSOs to drive improvements in patient safety using health IT
- Tools, knowledge, and resources offered in this chapter can help lay the foundation for a strong health IT strategic plan that can assist organizations as they strive to capture the full potential of their systems
- In summary, healthcare organizations need to ensure the safety of their health IT systems
- All stakeholders must become involved and increasingly transparent as they learn and share their safety lessons from the implementation and use of health IT
- In light of the fact that the EHR is fast becoming the standard in healthcare today, it is imperative that organizations commit time, energy, and funding to ensure that these clinical systems are integral to reaching their error reduction goals

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

CHAPTER REVIEW QUESTIONS

Question 29.1: What are the two main objectives of ONC's Action and Surveillance plan?

- **a.** (1) Use health IT to make care safer and (2) Continuously improve the safety of health IT
- **b.** (1) Use health IT to make care more efficient and (2) Continuously improve the costs of care
- **c.** (1) Use health IT to make care more effective and (2) Continuously improve healthcare outcomes
- **d.** (1) Use health IT and make care safer and (2) Continuously improve costs of care

Question 29.2: What Agency within HHS has a Common Format for reporting safety?

- **a.** HHS in the Office of National Coordinator
- **b.** The NIH National Library of Medicine
- **c.** AHRQ
- **d.** CMS

Question 29.3: What are some of the patient safety domains set forth by CMS's Partnership for Patients?

- **a.** Adverse drug events, Catheter associated urinary tract infections, and Central line associated blood stream infections
- **b.** Readmissions, Ventilator associated pneumonia, Pressure ulcers, and Surgical line infections
- **c.** Obstetrical adverse events, Venous thromboembolism, and Injuries from falls and immobility
- **d.** (a), (b), and (c). All of the above

Question 29.4: What is the role of the FDA in patient safety?

- **a.** FDA receives medical device reports (MDRs) of suspected device-associated deaths, injuries, or system malfunctioning
- **b.** There is no role for the FDA in patient safety
- **c.** The FDA receives reports of no medication or medical devices in the United States
- **d.** (b) and (c) only

Question 29.5: The FDA database for entering medical device errors is called _____

- **a.** MAUDE
- **b.** HEDIS
- **c.** ORYX
- **d.** None of the above

Question 29.6: Name a Patient Safety Organization (PSO) in the United States.

- **a.** ISMP
- **b.** JCO
- **c.** HEDIS
- **d.** ORYX

Question 29.7: Name Web-based tools that are available as resources to improve patient safety.

- **a.** The Guide to Reducing Unintended Consequences in Health Information Technology
- **b.** The Safety Assurance Factors for EHR Resilience (SAFER) Guides
- **c.** ECRI Institute's "How to Identify and Address Unsafe Conditions Associated with Health IT and The CPOE Design Recommendations Checklist, and the Pick-list Checklist"
- **d.** All of the above

Question 29.8: What other programs does the ONC align with to establish priorities in health IT safety work?

- **a.** The National Quality Strategy (NQS)
- **b.** The Meaningful Use program as part of the HITECH Act
- **c.** The Centers for Medicare and Medicaid Service's (CMS) Partnership for Patients initiative
- **d.** All of the above

Question 29.9: Name one private organization that is involved in patient safety.

- **a.** The Institute for Safe Medication Practices (ISMP) is devoted entirely to medication error prevention and safe medication use
- **b.** The Institute of Medicine
- **c.** The Joint Commission on Accreditation
- **d.** The CMS Partnership for Patients

Question 29.10: Which coalition has developed standards that recommend testing of CPOE to ensure that their inpatient systems can prevent common prescribing errors?

- **a.** The Joint Commission on Accreditation
- **b.** The Leapfrog Group
- **c.** The Institute of Medicine
- **d.** The Institute for Safe Medication Practices

ANSWERS AND EXPLANATIONS

Question 29.1: (a) (1) Use health IT to make care safer and (2) Continuously improve the safety of health.

Question 29.2: (c) AHRQ develops and maintains a set of Common Formats that include a set of common definitions and reporting formats that allow organizations to collect and submit standardized information regarding health IT-related patient safety events and hazards.

Question 29.3: (d) All of the above. CMS's Partnership for Patients domains include: Adverse drug events, Catheter associated urinary tract infections, Central line associated blood stream infections, Readmissions, Ventilator associated pneumonia, Pressure ulcers, Surgical line infections, Obstetrical adverse events, Venous thromboembolism, Injuries from falls and immobility.

Question 29.4: (a) The FDA receives several hundred thousand medical device reports (MDRs) of suspected device-associated deaths, injuries, or system malfunctioning.

Question 29.5: (a) The Manufacturer and User Facility Device Experience or MAUDE database for centralized housing, analysis, and reporting by the FDA.

Question 29.6: (a) ISMP receives hundreds of error reports from healthcare professionals, and is certified as a Patient Safety Organization (PSO) by AHRQ.

Question 29.7: (d) All of the above. Tools include the Web-based Guide to Reducing Unintended Consequences in Health Information Technology; the Safety Assurance Factors for EHR Resilience (SAFER) Guides; ECRI Institute's "How to Identify and Address Unsafe Conditions Associated with Health IT; the CPOE Design Recommendations Checklist; and the Pick-list Checklist".

Question 29.8: (d) All of the above. To establish priorities in health IT safety work, ONC aligns with the National Quality Strategy (NQS), the Meaningful Use program as part of the HITECH Act, and the Centers for Medicare and Medicaid Service's (CMS) Partnership for Patients initiative.

Question 29.9: (a) The Institute for Safe Medication Practices (ISMP) is devoted entirely to medication error prevention and safe medication use.

Question 29.10: (b) The Leapfrog Group, a coalition of healthcare purchasers, developed a CPOE "standard" including a requirement that organizations operating CPOE systems should demonstrate (via testing scenarios) to ensure that their inpatient CPOE system can alert physicians to at least 50 percent of common serious prescribing errors.

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The Role of Technology in the Medication-Use Process

• OBJECTIVES

1. Describe factors that will influence the adoption of technology in healthcare.
2. Describe the challenges and rewards related to implementing a computerized prescriber order entry system (CPOE).
3. Recognize the benefits and limitations of barcode-assisted medication administration (BCMA) technology as it relates to overall efforts to reduce medication errors, including errors using these systems.
4. Define the benefits and limitations of automated dispensing cabinets (ADCs) in healthcare and their application to the medication-use process.
5. Describe the benefits and limitations of smart infusion pump technology.
6. Recognize the value of and a methodology for assessing an organization's readiness for implementing technology.

• KEY WORDS

Automated dispensing cabinet
Barcode-assisted medication administration technology
Computer prescriber order entry
Failure mode and effects analysis
High-alert medications
Medication error
Smart infusion pump delivery systems

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of how to improve patient safety using technology? Does technology always improve patient safety? What are some high-risk industries that are high reliability? What is the name of the IOM report that brought attention to patient safety? How do you define safety? When do you know when an environment is safe?

For a WIIFM statement, say to the class, "in this chapter you will learn more about the advantages and disadvantages of technology. Nurses have the responsibility to become familiar with the availability of 'safety' technology, its advantages and disadvantages, and to work in collaboration with other healthcare stakeholders in the search for new and innovative technologic solutions to improve patient safety." As a nurse, it is important to understand the use of technology in clinical practice to improve patient safety.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   - **a.** Due to the numerous steps required in the care of patients, the healthcare industry is inherently error-prone and fraught with opportunities for mistakes to occur
     - **(1)** This concept was confirmed in the oft-quoted 1999 Institute of Medicine (IOM) report, *To Err Is Human: Building a Safer Health System*, where the authors extrapolated that between 44,000 and 98,000 patients die each year in the United States from preventable medical error
     - **(2)** These deaths were the results of practitioner interactions with "bad systems"
     - **(3)** The authors emphatically state that the healthcare industry must place safety as the number 1 national priority and work diligently toward this goal
     - **(4)** One explicit recommendation emanating from the first of a series of IOM reports on healthcare is to improve the safe design of systems as is presently being employed in the aerospace and nuclear industries, which are also highly error-prone fields
     - **(5)** These industries not only acknowledge and accept the notion that individuals will make errors from normal mental slips and lapses in memory, but recognize that enhancing safety system design through the use of technology is an invaluable tool in the prevention of potentially life-threatening mistakes
     - **(6)** Estimates on the financial impact of adverse drug events (ADEs) attribute $2 billion of increased hospitalization costs to preventable ADEs
     - **(7)** The 2006 IOM report, *Preventing Medication Errors*, noted that to deliver safe drug care, healthcare organizations should make effective use of well-designed technologies, which will vary by setting
     - **(8)** Although the evidence for this assertion is strongest in the inpatient setting, the use of technology will undoubtedly lead to major improvements in all settings
     - **(9)** In 2009, the American Recovery and Reinvestment Act (ARRA) invested $25.8 billion into healthcare to incentivize the adoption, standardization, and meaningful use of health information technology

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Technology and Healthcare

1. Overview
   - **a.** In the past, the majority of technology acquisitions have consisted of basic stand-alone computer systems, which were primarily used for data input to increase each department's efficiency with financial accountability measures
     - **(1)** These computers were generally installed in the pharmacy, radiology, and laboratory departments, and could also be found in the administration and business offices
     - **(2)** Each department was allowed to evaluate and purchase their own unique computer system, preventing any integration of data or dissemination of critical patient information, which is indispensable in providing safe care
     - **(3)** But even as improving technologies have emerged allowing for seamless integration of information to occur, organizations are challenged with the huge costs associated with replacing their nonintegrated computer systems
     - **(4)** According to an American Society of Health-System Pharmacists (ASHP) survey in 2011, 66.7% of the responding hospitals stated that they had the components of an electronic medical record (EMR), but completely digital hospitals with fully implemented EMRs is far in the future, considering only 8% of hospitals were fully digital (without paper records)
     - **(5)** An estimated 34.2% of hospitals were using computerized prescriber order entry systems (CPOE) with decision support, 50.2% use barcode medication administration, and 67.9% were using intelligent infusion devices (smart pumps)

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Influences on the Adoption of Technology

1. Overview
   - **a.** Consumers have become increasingly concerned that hospitals are less than safe following the numerous mass media reporting of medical mistakes, which have resulted in patient harm and deaths
     - **(1)** In 1995, there were television and newspaper accounts that reported the tragic death of a patient from a preventable ADE due to an inadvertent administration of a massive overdose of a chemotherapy agent over 4 days
     - **(2)** This particular error became a watershed event for patients, practitioners, and healthcare organizations alike, not only because it occurred at the world renowned Dana Farber Cancer Institute, but also because it happened to the prestigious *Boston Globe* healthcare reporter, Betsy Lehman
     - **(3)** How could a mistake of this proportion occur in a leading healthcare facility where each practitioner is specifically educated in the care and treatment of cancer patients?
     - **(4)** A root cause analysis of the error revealed that there was no malpractice or egregious behavior, but that excellent, conscientious, and caring pharmacists and nurses simply interpreted an ambiguous handwritten chemotherapy order incorrectly

(5) In retrospect, if technology had been available, the physician could have entered the medication order into a CPOE system and this heartbreaking error may not have happened

(6) Unfortunately, this example is by far not an isolated case

b. According to a 1994 American Medical Association report, medication errors related to the misinterpretation of physicians' prescriptions were the second most prevalent and expensive claim listed on malpractice cases filed over a 7-year period on 90,000 malpractice claims between 1985 and 1992

(1) Also, it has been estimated in the outpatient setting that indecipherable or unclear orders resulted in more than 150 million telephone calls from pharmacists and nurses to prescribers requiring clarification, which not only is time-consuming for practitioners, but estimated to cost healthcare systems billions of dollars each year

(2) Thus, the availability of critical clinical information needed at the point-of-care (during prescribing, dispensing, and administering) can not only improve time management and contribute to cost-savings through improved utilization of medications, staff and patient satisfaction, but most importantly, reduce the incidence of error

c. The first organized attempt to move acute care organizations toward improving patient safety through technology began from an initiative by The Leapfrog Group

(1) Composed of more than 150 private and public organizations providing healthcare benefits, this group felt that they had a significant financial investment in preventing errors for their employees, thus increasing productivity by contracting only with those organizations that had hospital-wide adoption of CPOE technology

(2) Yet, a survey by Leapfrog completed in 2003 showed that not only did this financial incentive result in no increase from the 2002 survey in the number of hospitals that had implemented CPOE, but there was also a drop of 17% in hospitals now fully committed to CPOE implementation before 2005

(3) According to Leapfrog, 26% of the 1244 hospitals that completed their survey in 2009 report having a CPOE system in at least one inpatient department

(4) Even if an organization implements CPOE, this does not mean that the system will catch incorrect medication orders entered into the system

(5) Another report from Leapfrog, based on a study between June 2008 and January 2010 of 214 hospitals from across the United States who completed Leapfrog's CPOE evaluation tool, revealed that these systems potentially missed half of the routine medication orders and one-third of potentially fatal medication orders

(6) Because little research is available on the effectiveness of CPOE on medication error prevention, other organizations such as the Joint Commission, a nonprofit organization that is the nation's leading standards-setting and accrediting body in healthcare and the National Quality Forum (NQF) are presently refraining from uniformly requiring its adoption

d. Probably the most important development to promote the implementation of technology is the announcement by the Centers for Medicare and Medicaid Services (CMS) of a proposed rule to implement provisions of the American Recovery and Reinvestment Act of 2009 (Recovery Act) that provide incentive payments for the meaningful use of certified electronic health records (EHR) technology

(1) The Medicare EHR incentive program will provide incentive payments to eligible professionals, eligible hospitals, and critical access hospitals that are meaningful users of certified EHR technology

(2) The Medicaid EHR incentive program will provide incentive payments to eligible professionals and hospitals for efforts to adopt, implement, or upgrade certified EHR technology or for meaningful use in the first year of their participation in the program and for demonstrating meaningful use during each of five subsequent years

e. Interest in the use of barcoding technology increased due to the Food and Drug Administration's (FDA's) February 25, 2004 ruling, which required medications to have machine-readable barcodes

(1) In an optimally acute care, barcoded environment, a nurse would scan his or her barcode identification badge at the beginning of each medication administration time, the patient's barcode identification band, and the intended drug's barcoded label with a barcode scanner

(2) A mismatch between the patient, the drug packaging applied during manufacturing or repackaging, an incorrect time, dose, route, and the patient's medication record would trigger a warning, prompting the nurse to investigate the discrepancy before administering the medication

(3) One of the first healthcare facilities to adopt barcode technology was due to the inspiration of a nurse at the Department of Veterans Affairs (VA) in Topeka, Kansas

(4) Her insight resulted in a 74% improvement in errors caused by the wrong medications being administered, a 57% improvement in errors caused by incorrect doses being administered, a 91% improvement in wrong patient errors, and almost a 92% improvement in wrong time errors between 1993 and 1999

(5) Additional examples of evolving technology used to prevent medication errors include automated dispensing cabinets (ADCs) and smart infusion pumps

(6) As more technology systems are introduced into healthcare, it is important that nurses understand their benefits and problems, and how technology will affect their practice

(7) As noted by the IOM report, *Keeping Patients Safe: Transforming the Work Environment of Nurses*, despite its potential, patient safety experts caution that technology by itself is not a panacea

(8) While able to remedy some problems, technology may also generate new forms of error and failure

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Computerized Prescriber Order Entry (CPOE)

1. Overview

- **a.** To a large degree, healthcare practitioners still communicate information in the "old-fashioned way"
  - **(1)** According to the aforementioned ASHP technology survey, 34.2% of US hospitals had a CPOE system in 2011, which was a 45% increase from the preceding year
  - **(2)** The survey showed that larger hospitals had a CPOE system compared to smaller hospitals
- **b.** Many factors demonstrate the need for a shift from a traditional paper-based system that relies on the practitioners' vigilance to automated order entry, record keeping, and clinical care
  - **(1)** These factors include accessing patient information spread across multiple organizations that may be unavailable, especially in large organizations and, therefore, medical care would be provided without pertinent patient information
  - **(2)** The structure of the patient's record often makes it difficult to locate valuable information as well as illegible handwritten entries by healthcare practitioners, and for those patients with chronic or complex conditions, the records can increase to multiple volumes over many years
  - **(3)** These problems result in a variety of communication breakdowns when providing healthcare to patients from the duplication of services, delays in treatment, increased length of stay, and increased risk of medical errors. Additionally, human memory-based medicine can be inaccurate or not recalled
- **c.** There are also many barriers that lead to ineffective communication of medication orders that include issues with illegible handwriting, use of dangerous abbreviations and dose designations, and verbal and faxed orders
  - **(1)** Studies have shown that as a result of poor handwriting, 50% of all written physician orders require extra time to interpret. Sixteen percent of physicians have illegible handwriting
  - **(2)** Illegible handwriting on medication orders has been shown to be a common cause of prescribing errors and patient injury and death have actually resulted from such errors
  - **(3)** In a study at a large teaching hospital, published in 2005, one in three house physicians and medical students who believed their orders were always legible had been asked to clarify them because of poor legibility
  - **(4)** Illegible orders may also lead to delays in the administration of medications
  - **(5)** To clarify these illegible orders, the healthcare practitioner's workflow is typically interrupted
- **d.** The use of a CPOE system has the potential to alleviate many of these problems. CPOE systems allow physicians to electronically order medications, tests, and consultations
  - **(1)** They also provide advice on best practices and alerts to the possible adverse consequences of a therapy, such as an allergy or a harmful combination of drugs
  - **(2)** But there are many other potential enhancements that even a basic CPOE system could offer to further enhance safe medication ordering practices, including
    - **i.** Features unique to the acute care setting, ambulatory care setting or both
    - **ii.** Prescribers access to records and ability to enter orders from their office or home; prescriber selectable, standardized single orders or order sets; implementation of organization-specific standing orders based on specific situations such as before or after procedures
    - **iii.** Menu-driven, organization-specific lists of medications on formulary
    - **iv.** Passive feedback systems that present patient-specific data in an organized fashion, such as test results, charges, reference materials, and progress notes, or active feedback systems to provide clinical decision-making tools by providing specific assessments or recommendations through alerts and reminders or even therapeutic suggestions at the time the order is entered
- **e.** CPOE systems offer many other advantages over the traditional paper-based system
  - **(1)** They can improve quality, patient outcomes, and safety by a variety of factors such as increasing preventive health guideline compliance by exposing prescribers to reminder messages to provide preventive care by encouraging compliance with recommended guidelines, identifying patients needing updated immunizations or vaccinations, and suggesting cancer screening and diagnosis reminders and prompts
  - **(2)** Other advantages include reductions in the variation in care to improve disease management by improving follow-up of newly diagnosed conditions, reminder systems to improve patient management, automating evidence-based protocols, adhering to clinical guidelines, or providing screening instruments to help diagnosis disorders
  - **(3)** Order entry systems can improve drug prescribing and administration by driving formulary usage, improving antibiotic usage, suggesting whether certain antibiotics or their dosages are appropriate for use
  - **(4)** Medication refill compliance can be increased using reminder systems to increase adherence to therapies
  - **(5)** Drug dosing could be improved, especially for those medications whose dosing is based on laboratory results, such as heparin or warfarin, to maintain adequate anticoagulation control

f. Many studies have demonstrated a reduction in ADEs, with the use of CPOE

   (1) For example

   - Bates and colleagues showed that serious medication errors were reduced by 55% and preventable ADEs were reduced by 17%
   - Another study has shown that non-missed-dose medication errors fell from 142/1000 patient-days to 26.6/1000 patient-days. The same study showed a reduction of nonintercepted serious medication errors from 7.6/1000 patient-days to 1.1/1000 patient-days
   - A study of a pediatric critical care unit found a 41% reduction in potentially dangerous errors after implementation of CPOE
   - An evaluation of the potential benefit of CPOE over pharmacist review for ordering errors demonstrated that CPOE could reduce potentially dangerous prescribing errors, but would have no effect on administration errors, which have a high risk of patient injury
   - In a meta-analysis of 12 original investigations that compared rates of prescribing medication errors with handwritten and computerized physician orders, 80% of those studies reported a significant reduction in total prescribing errors, 43% in dosing errors, and 37.5% in ADEs
   - A study of a neonatal intensive care unit (NICU) in a tertiary care center showed that the number of orders with no opportunity for errors improved from 42% to 98% after the implementation of CPOE

g. In addition, errors of omissions would be reduced, such as failure to act on results or carry out indicated tests

   (1) Handwriting and interpretation issues would be eliminated

h. There would be fewer handoffs if the CPOE system was linked to information systems in ancillary departments which would eliminate the need for staff members to manually transport orders to the pharmacy, radiology department, and laboratory, resulting in fewer lost or misplaced orders and faster delivery time

   (1) The system has also eliminated the need for staff members in those departments to manually enter the orders into their information systems, reducing the potential for transcription errors

   (2) Medical data capture and display would be improved, enabling a more comprehensive and accurate documentation by prescribers and nurses

   (3) Access to pertinent literature and clinical information from knowledge bases and literature sources would enable ready access to updated drug information

   (4) These obvious improvements to patient care would not only improve patient safety, but also increase efficiency, productivity, and cost-effectiveness

i. CPOE systems can offer a variety of solutions to help reduce the cost in providing healthcare and making more appropriate utilization of services

   (1) In the outpatient setting, reductions in hospitalizations and decreased lengths of stay can be obtained from automated scheduling of follow-up appointments to reducing unnecessary diagnostic tests

   (2) Better use of formulary and generic drugs can be achieved by providing feedback of prescribing charges and patterns to encourage prescribers to substitute generic medications for more expensive branded medications

   (3) Properly designed systems can show an improvement in workflow and time-saving measures for prescribers, if the program makes sense to the prescriber and follows a rational process while performing order entry, by improving the availability and responses to information regarding diagnosis and treatment

   (4) Savings related to the storage of paper medical records could be substantial, compared with the cost of storing computerized backup storage devices

   (5) Entering medication and diagnostic orders into a computer system would allow for instantaneous capturing of charges, therefore enhancing revenue

   (6) Costs associated with the use of transcription notes would be eliminated as well by using an electronic patient record system

   (7) Lastly, there is patient and user satisfaction

   (8) Despite the many documented benefits of using a computerized system, many roadblocks and safety issues exist

   (9) One primary area of concern revolves around the costs of implementing CPOE, which are estimated to be about $8 million, with $1.35 million in annual maintenance for a 500-bed hospital

   (10) For a 720-bed tertiary hospital, the cost was estimated to be $11.8 million for the development, implementation, and operation of CPOE over a 10-year period

   (11) Investing in a CPOE system is not analogous to purchasing software off the store shelf, and it involves far more resources than spending money on a software package

   (12) Hospitals will need a minimum infrastructure to support its use, such as a fiber optic backbone network; time, space, and manpower to provide adequate staff education and development; and workstations and high-speed Internet access

   (13) The process of selecting the vendor is a costly and difficult process, especially if a vendor cannot address

Teaching Tip

Provide the example, the admission process for patients from the outpatient setting into an acute care organization can be a cumbersome and time-consuming process. Electronic systems would improve communication, if connected to an outpatient clinical referral system, by decreasing the amount of time needed to complete the referral process in addition to providing important patient information such as patient allergies and diagnosis. The time spent searching for or organizing paper-based information would be substantially reduced, thus improving prescriber and nurse satisfaction as well.

the organization's specific needs. In addition, staff resources will be needed to develop and program organization-specific rules, guidelines, or protocols and to implement the system, plus provide ongoing support for any needed enhancements or changes to the system

(14) It is also difficult to prove or demonstrate any quantifiable benefits or returns on investment because it is hard to accurately measure the actual costs of using paper-based records

j. Benefits such as provider convenience, patient satisfaction, and service efficiency are not easily captured on the bottom line in terms of increase in revenue, decrease in expense, or avoidance of expense

- **(1)** Add on top of these competing priorities, including other forms of automation to enhance medication safety, such point-of-care barcoding systems and smart infusion pumps that are currently on the market
- **(2)** Another challenge involves the integration of "legacy" systems, those that have been in institutions for many years, which already exist in healthcare organizations
- **(3)** Many organizations are risk averse, waiting to let others be the clinical pioneers before they invest in these systems
- **(4)** Finally, despite the prospects of enhanced workflow and reduction in medication errors, there are real and potential problems with even the best CPOE systems

k. As previously mentioned, CPOE systems have demonstrated a reduction in ADEs

- **(1)** Unfortunately, unsafe prescribing practices and medication errors are still possible with these systems
- **(2)** Some organizations, in fear of alienating prescribers, have an active CPOE system, but the clinical order screening capability of warnings and alerts have been turned off
- **(3)** The capability to build rule-based safety enhancements, or clinical decision support (CDS), is often available in the software, but the actual rules, such as prompts for prescribers to order potassium replacement for patients with laboratory results below normal potassium levels, are not provided by the vendor nor are they typically programmed for use by organizations
- **(4)** CDS is a method for delivering clinical knowledge and intelligently filtered patient information to clinicians and/or patients for the purpose of improving healthcare processes and outcomes
- **(5)** CDS includes knowledge-delivery interventions, such as targeted documentation forms and templates, relevant data presentation, order and prescription creation facilitators, protocol and pathway support, reference information and guidance, and alerts and reminders

l. The Leapfrog CPOE evaluation tool has been promoted as a means of monitoring the efficacy of hospitals systems and their CDS

- **(1)** Results from a study designed to determine the relationship between Leapfrog scores and the rates of preventable ADEs and potential ADEs indicated that scores from the Leapfrog CPOE evaluation tool closely relate to actual rates of preventable ADEs and that Leapfrog testing may alert providers to potential vulnerabilities and highlight areas for further improvement

m. A study by Nebeker and colleagues showed that high rates of ADEs may continue after CPOE implementation if the system lacks CDS for drug selection, dosing, and monitoring

- **(1)** Studies have shown those prescribers, using only the basic CPOE system alone, order appropriate medication doses for patients 54% of the time
- **(2)** By comparison, prescribers using the CPOE system with decision support tools prescribed appropriate doses 67% of the time
- **(3)** The addition of the decision support tools also increased the percentage of prescriptions considered ordered at appropriate intervals to 59%, from 35% with the basic CPOE system
- **(4)** A national sample of 62 hospitals voluntarily used a simulation tool designed to assess how well safety decision support worked when applied to medication orders in computerized order entry
- **(5)** This simulation detected only 53% of the medication orders that would have resulted in fatalities and 10–82% of the test orders that would have caused serious ADEs

n. Complex and time-consuming order entry processes can often lead to practitioner frustration as evidenced by potential increases in the use of verbal orders, another error-prone process in communicating medication orders

- **(1)** Computer issues such as error messages, frozen screens, slow access to information, and other issues lead to problems of accessing critical patient or drug information as well as adding to prescriber frustration
- **(2)** It is important to have the ability to access past patient histories, particularly previous ADEs and comorbid conditions, yet some systems are unable to access prior patient care encounters
- **(3)** Problems may arise if drug information updates are not performed on a timely basis or if this information is difficult to access
- **(4)** One key error reduction strategy is the ability to install user-defined warnings (e.g., "look-alike/sound-alike" drug name alert), yet some systems do not allow for this type of customization

o. New types of medication errors can occur with the use of CPOE such as wrong patient errors, when the wrong patient is selected from a menu list of similar patient names; wrong drug errors, when the wrong medication is selected from a list due to look-alike similarity in either the brand or generic name; or orders intended for laboratory levels that are filled as medications

- **(1)** A study that compared the manifestations, mechanisms, and rates of system-related errors associated with two electronic prescribing systems showed that 27.4% of system-related errors manifested as timing errors, 22.5% wrong drug strength errors, and selection errors accounted for 43.4% (34.2/100 admissions)

- **(2)** Another study that attempted to quantify the frequency and analyze risk factors for patient mis-selection errors when entering orders revealed many contributing factors, including similarly spelled last names when picking patient names from a list, having multiple charts opened at the same time, and distractions

p. Even though CPOE systems are intended for use by prescribers, their presence in organizations will affect nursing and other personnel as well. CPOE systems will affect or even change the work of nurses in many ways, both negative and positive

- **(1)** First, like prescribers, these systems will require nurses to possess basic computer skills
- **(2)** Depending on the design of the system, nurses may find it difficult to know when new orders have been entered into the system, a special concern with respect to "STAT" or other new orders
- **(3)** Nurses sometimes see off-site entry of orders by prescribers as detrimental, because it reduces the opportunity to communicate information or ask questions face-to-face with prescribers with regard to the care of patients
- **(4)** In some situations, prescribers are reluctant to enter orders and use verbal orders as a way of "getting around" entering orders into the CPOE system and, in fact, nurses may end up entering verbal orders from prescribers

q. But there are many beneficial aspects of these systems for nurses

- **(1)** Providing the capability for computerized physician order entry and making patient education material available electronically to nurses also have been identified as strategies to facilitate communication
- **(2)** With computerized physician order entry, nurses do not have to engage in transcription or verification of orders
- **(3)** Electronic patient education materials, unlike printed materials,
  - **i.** Are easily modifiable to meet clinician and patient needs
  - **ii.** It is also possible to track which materials were given and by whom, assess follow-up and comprehension, and link education activities and documentation
- **(4)** Nurses may have more time with patients due to enhanced productivity due to a reduced frequency in contacting prescribers to clarify orders
- **(5)** Additionally
  - **i.** There would be reductions in time wasted in transcribing duplicate orders for the same medication or test
  - **ii.** Greater standardization of orders, lessening the need to understand and adhere to diverse regimens and schedules
  - **iii.** Improved efficiency when ordering tests or procedures, thus reducing time devoted to carrying out redundant orders
  - **iv.** Less need to enter voice orders into the system as prescribers gain access to the system from other units and remote locations
- **(6)** Finally, orders would be usually executed faster, medications would be available more quickly, and patients receive care more promptly
- **(7)** It is important for healthcare administration and nurses to understand that for a CPOE system to work as intended, it must be fully utilized by prescribers

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Barcode-assisted Medication Administration (BCMA)

1. Overview

a. Nurses play a vital role in the medication-use process, ranging from their involvement in the communication of medication orders to the administration of medications

- **(1)** As nurses know well, the administration of medications can be a labor-intensive and error-prone process
- **(2)** One study showed that 38% of medication errors occur during the drug administration process
- **(3)** While about half of the ordering, transcribing, and dispensing errors were intercepted by the nurse before the medication error reached the patient, almost none of the errors at the medication administration stage were caught
- **(4)** In another study of medication administration errors in 36 healthcare facilities, Barker et al. found that some type of medication administration error occurred in almost 20% of medication doses administered
- **(5)** In addition, nurses are burdened with larger patient loads and are caring for patients with higher degrees of acuity than ever before
- **(6)** To make matters worse, the number of medications that have reached the market has grown 500% over the past 10 years to more than 17,000 trademarked and generic drugs in North America
- **(7)** Rapid advances in technology have helped to make this process more efficient and safe
- **(8)** One form of technology that will have a great impact on medication safety during the administration process is BCMA technology

b. For more than 20 years, barcode technology has clearly demonstrated its power to greatly improve productivity and accuracy in the identification of products in a variety of business settings, such as supermarkets and department stores

- **(1)** Proven to be an effective technology, it quickly spread to virtually all other industries
- **(2)** Yet, many organizations in the healthcare industry have not fully embraced this valuable technology as a method to enhance patient safety

c. The 2011 ASHP National Survey reported that approximately 50% of hospitals stated using barcode technology

- **(1)** This number has increased significantly over the past year, with implementation rates improving by 45%

  (2) This survey showed that all VA hospitals used BCMA, and general and children's medical-surgical hospitals with 100–399 beds were more likely to have BCMA to verify the accuracy of medication administration at the point-of-care

  (3) The reasons for these few numbers are varied and may include the cost of implementation, challenges integrating with current informatics systems, and prioritization among other information technology projects

  (4) The survey also revealed that larger hospitals (400 or more staff beds) had adopted CPOE before starting to adopt BCMA

d. For the healthcare industry, the potential effect of implementing barcode technology to improve the safe administration of medications is enormous

  (1) As previously stated, the VA Healthcare System, a pioneer in the use of barcode technology, looked at their medication error rate based on the number of incident reports related to medication errors before and after implementation of the BCMA system

  (2) The study showed that following the introduction of the BCMA, reported medication error rates declined from 0.02% per dose administered to 0.0025%

  (3) This is almost a 10-fold reduction in errors over 8 years

  (4) In a study that used the direct-observation methodology to monitor medication administration before and after the deployment of electronic medication administration records (eMARs) and BCMA systems showed a 54% reduction of medication administration errors

  (5) In another study that assessed rates of errors in order transcription and medication administration on units before and after implementation of the BCMA, observers noted an 11.5% error rate in medication administration on units that did not use the BCMA versus a 6.8% error rate on units that did use it—a 41.4% relative reduction in errors

  (6) The rate of potential ADEs (other than those associated with timing errors) fell from 3.1% without the use of the BCMA to 1.6% with its use, representing a 50.8% relative reduction

  (7) Procedural areas and emergency departments (EDs) are often times excluded from the implementation of BCMA systems due to distinct differences from typical patient care areas

  (8) One recent study showed that, in addition to being feasible, the implementation of a BCMA system was associated with a relative reduction of medication administration errors by 80.7%

e. BCMA can improve medication safety through several levels of functionality

  (1) At the most basic level, the system helps to verify that the right drug is being administered to the right patient at the right dose by the right route and at the right time

  (2) On admission, patients are issued an individualized barcode wristband that uniquely identifies their identity

  (3) When a patient is to receive a medication, the nurse scans their barcoded employee identifier and the patient's barcode wristband to confirm their identity

  (4) The Joint Commission has stated that a barcode with two unique, patient-specific identifiers will provide healthcare organizations a system that complies with the 2014 National Patient Safety Goal requirement of obtaining two or more patient identifiers before medication administration

  (5) Prior to medication administration, each barcoded package of medication to be administered at the bedside is scanned

  (6) The system can then verify the dispensing authority of the nurse, confirm the patient's identity, match the drug identity with their medication profile in the pharmacy information system, and electronically record the administration of the medication in an eMAR system

f. The use of an eMAR is likely to be more accurate than traditional handwritten MARs

  (1) One study showed that by using BCMA, the medication-verification component greatly facilitates the documentation process for nurses and may be an important factor for its acceptance

  (2) In a survey of nurses who worked in a variety of clinical settings, the nurses believed that using barcoding and eMARs at the bedside was more time-consuming, but they acknowledged that the extra time was worth it to assure verification

  (3) Saving time on transcribing orders or trying to read handwritten, paper-based medication sheets was seen by many to be a significant positive change

  (4) Furthermore, the barcode scanner can enable nurses to have greater accuracy in recording the timing of medication administration, as the computer generates an actual "real-time" log of medication administration

  (5) Additional levels of functionality can include some of the following features

    - Up-to-date drug reference information from online medication references. This could include pictures of tablets or capsules, usual dosages, contraindications, adverse reactions, and other safety warnings, pregnancy risk factors, and administration details
    - Customizable comments or alerts (e.g., look-alike/sound-alike drug names, special dosing instructions [e.g., 2 tablets = 10 mg]) and reminders of important clinical actions that need to be taken when administering certain medications (e.g., do not crush; respiratory intubation is required for neuromuscular blockers)
    - Monitoring the pharmacy and the nurse's response to predetermined rules such as alerts or reminders. This includes allergies, duplicate dosing, over/under dosing, checking for cumulative dosing for medications with established maximum doses such as acetaminophen
    - Reconciliation for pending or STAT orders (i.e., a prescriber order not yet verified by a pharmacist). The ability of the nurse to enter a STAT order into the system on administration that is linked directly to the pharmacy profile and prevents the duplicate administration of the same medication
    - Capturing data for the purpose of retrospective analysis of aggregate data to monitor trends (e.g.,

percentage of doses administered late; alerts that were overridden). However, this analysis should *not* be used to assess employee performance, especially if it could lead to punitive action

- Verifying blood transfusion and laboratory specimen collection identification
- Increased accountability and capture of charges for items such as unit stock medications

g. It is important to understand that the successful implementation of an effective BCMA system "forces" nurses to accept and change some of their long-held practices when administering medications to achieve a higher level of medication safety

(1) When BCMA technology is used correctly, it drives compliance with the proper identification of patients, it documents real-time administration, and acts as a double-check

(2) It is also vitally important to its success that affected staff members, and specifically frontline nurses, are involved in all the decisions related to the purchase, education, and implementation of barcode technology

(3) Before embarking on a BCMA implementation, it is critical to anticipate potential failures and develop contingency plans for unexpected results

(4) In a study that evaluated the workflow variables related to a bedside barcode technology-based medication administration process, the authors concluded that nurses were found to be primarily engaged in tasks performed at the bedside

(5) However, tasks such as retrieving missed medications and routinely updating patients' vital assessment records added workflow blocks to the medication administration process

(6) A second study revealed that the introduction of BCMA in an intensive care unit (ICU) resulted in nursing spending less time on the documentation process and more time conversing with patients during the medication administration process

h. Of course, a stringent testing phase should also be built into the system rollout phase using a technique such as failure mode and effects analysis (FMEA) to proactively address potential sources of breakdowns, workarounds, or new sources of medication errors

(1) One study noted significant changes to workflow that occurred during the implementation of a BCMA system at VA hospitals that might lead to the use of workarounds

(2) Negative effects and corresponding workarounds include the following

- Nurses were sometimes caught "off guard" by the programmed automated actions taken by the BCMA software. For example, the BCMA would remove medications from a patient's drug profile list 4 hours after the scheduled administration time, even if the medications were never administered
- Inhibited coordination of patient information between nurses and physicians. Before the BCMA was implemented, the prescriber could quickly review the handwritten MAR at the patient's bedside or in the unit's medication room
- Nurses found it more difficult to deviate from the routine medication administration sequence with the BCMA system. For example, if a patient refused a medication, the nurses had to manually document the change since the medication had already been documented as given when it was originally scanned
- Nurses felt that their main priority was the timeliness of medication administration because BCMA required nurses to type in an explanation when medications were given even a few minutes late. Particularly in long-term care settings, some nurses were observed to scan and pre-pour medications for unavailable patients so that they would appear "on time" in the computer record, thereby relying on memory to administer unlabeled medications when the patient returned to the unit
- Nurses used strategies to increase efficiency that circumvented the intended use of BCMA

Teaching Tip

Provide the example, some nurses routinely entered a patient's social security number by typing the numbers rather than scanning the patient's barcode wristband, because typing seemed to be quicker. This was especially true if the nurse experienced difficulty in scanning the patient's barcode arm band (i.e., curvature of the barcode on the patient's wristband on patients with small wrists, or damaged barcodes).

i. The interaction between nurses and technology at the bedside is important and must be continually evaluated for safety

(1) As previously mentioned, nurses tend to develop workarounds for ineffective or inefficiently designed systems

(2) Koppel, Wetterneck, Telles, and Karsh sought to identify reasons for workarounds and found three categories that capture this phenomenon

  i. Omission of process steps
  ii. Steps performed out of sequence
  iii. Unauthorized process steps

Teaching Tip

Provide the example, the authors identified 15 types of workarounds, including, for example, affixing patient identification barcodes to computer carts, scanners, doorjambs, or nurses' belt rings; carrying several patients' pre-scanned medications on carts. The authors identified 31 types of causes of workarounds, such as unreadable medication barcodes (crinkled, smudged, torn, missing, covered by another label); malfunctioning scanners; unreadable or missing patient identification wristbands (chewed, soaked, missing); non-barcoded medications; failing batteries; uncertain wireless connectivity; emergencies.

(3) The authors found nurses overrode BCMA alerts for 4.2% of patients charted and for 10.3% of medications charted

(4) The possible consequences of the workaround include wrong administration of medications, wrong doses, wrong times, and wrong formulations

  - **(5)** Shortcomings in BCMA design, implementation, and workflow integration encouraged workarounds

- **j.** One medication error reported to ISMP caused by a workaround (overriding an alert), involved a mix-up with an order for digoxin elixir (used for congestive heart failure), which was stocked on the unit as a 0.05 mg/mL, 60 mL multidose bottle (usual dose is 0.125–0.25 mg [2.5–5 mL])
  - **(1)** The nurse not only misinterpreted the dose of digoxin elixir as 60 mL, but accidentally retrieved a bottle of doxepin (used for depression), which was available as 10 mg/mL (usual dose is 75–150 mg per day [7.5–15 mL]) from unit stock and attempted to administer what she thought was digoxin elixir
  - **(2)** This error occurred because she scanned the barcode on the bottle, which generated an error window on the laptop computer screen stating "drug not on profile" and did not investigate the error
  - **(3)** The system allowed the nurse to manually enter the wrong medication's national drug code (NDC) number (a medical code set that identifies prescription drugs and some over-the-counter products), ignoring the correct drug NDC number that had been entered by the pharmacy which appeared on the laptop screen and administered 60 mL of doxepin elixir
  - **(4)** This allowed the nurse a method to bypass the check system and simply type in numbers and administer a drug, whether it was the right or wrong ordered medication
- **k.** Alerts that are generated by BCMA systems often may not be noticeable

Teaching Tip

Provide the example, a system may generate a visual display of the alert but not provide a distinct auditory alert. If a nurse does not look at the screen for any alerts after scanning a patient's wristband and/or barcoded medications, errors will ensue. Additionally, the alerts are not hard-stops, meaning that the system does not physically stop a practitioner from proceeding with scanning or administering a medication. Problems have also occurred when other processes surrounding medication administration have broken down. Although the steps directly involved with the scanning of the medication and the patient may be completed, errors can be introduced if distractions occur or medications are laid down after the scanning process.

- **l.** One major issue that initially hindered the widespread implementation of BCMA systems was with the pharmaceutical industry's unwillingness to adopt a universal barcode standard and apply a barcode consistently to the container of all medications, including unit-dose packages
  - **(1)** But in February 2004, the FDA established a new rule that requires a barcode on most products in a linear format that meets the Uniform Code Council (UCC) or Health Industry Business Communications Council (HIBCC) standards
  - **(2)** This barcode must contain the product's NDC number, but the expiration date and lot numbers are optional (ISMP, 2004)
- **m.** Further complicating the issue is the unavailability of unit-dose packaging for some medications
  - **(1)** At this point, if hospital pharmacies that employ barcode technology cannot purchase medications that are packaged in a unit-dose system, they must repackage these medications and relabel each with a barcode
  - **(2)** This can only be done at considerable cost in manpower and/or automated repackaging equipment
  - **(3)** In addition, the chance of a medication error occurring is increased because doses must be taken from their original container and then repackaged or relabeled, and there could be an error in the application of the correct barcode label or in choosing the right medication
  - **(4)** One medication error reported to ISMP includes a scenario where a facility utilized a BCMA system for their inpatients where not all injectables had manufacturers' barcodes on the vials or ampules, and pharmacy technicians had to generate computer-printed barcodes for those products
  - **(5)** Prior to the intubation of a patient, a vial of succinylcholine chloride with an incorrect dose label was discovered
  - **(6)** The printed label read 20 mg/10 mL, whereas, the manufacturer's label read 20 mg/mL
  - **(7)** Had the patient received the incorrect dose, it would have been 10 times the dose needed
- **n.** The use of BCMA systems can possibly introduce new types of medication errors
  - **(1)** Although, few medication errors have been reported with these systems, it can be hypothesized that some of the following types of errors could occur, especially if the system includes only the most basic of functionality
    - **Wrong dosage form:** Certain drug shortages may force a pharmacy to dispense a different strength or concentration (mg/mL) other than what is entered in the BCMA software
    - **Omissions:** After the patient's barcode armband and medication have been scanned, the dose is inadvertently dropped onto the floor. This results in a time lapse between the documentation that the medication was supposedly administered and the actual administration after obtaining the new dose
    - **Extra dose:** An extra dose may be given when there are orders for the same drug to be administered by a different route. For example, if one nurse gives an oral dose and is called away and the covering nurse administers the dose intravenously (IV). The problem arises when there is no alert between profiled routes of administration indicating that the medication was previously administered by one route that is different than the second route
    - **Wrong drug:** In situations when the nurse received an alert indicating that the wrong medication was selected, but the alert is overridden and the medication is administered
    - **Wrong dose:** These systems are limited in their capability to verify the correct volume (e.g., 1 mL) of oral or parenteral solutions to administer. Most

systems prompt a nurse to manually enter the volume that was administered

- **Unauthorized drug:** An order to hold a medication unless a lab value is at a certain level, such as an aminoglycoside (i.e., elevated gentamicin drug level)
- **Charting errors:** Distinguish the indication for the administration of the medication (Tylenol 650 mg every 4 hours as needed for pain or fever)

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Automated Dispensing Cabinets (ADCs)

1. Overview
   - a. Traditionally, hospital pharmacies provided medications for patients by filling patient-specific bins of unit-dose medications, which were then delivered to the nursing unit and stored in medication carts
     - (1) The ADC is a computerized point-of-use medication-management system that is designed to replace or support the traditional unit-dose drug delivery system
     - (2) The devices require staff to enter a unique logon and password to access the system using a touch screen monitor or by using fingerprint identification
     - (3) Various levels of system access can be assigned to staff members, depending on their role in the medication-use process
     - (4) Once logged into the system, the nurse can obtain medications from drawers or bins that open after a drug is chosen from a pick list
   - b. Many healthcare facilities have replaced medication carts or open unit-stock systems with ADCs
     - (1) The results of an ISMP survey showed that 94% of hospital respondents were utilizing ADCs in their facilities; of those, more than half (56%) were using the technology as the primary means of drug distribution
     - (2) The 2011 ASHP national survey of pharmacy practice provided further evidence of a trend toward decentralized automated systems using ADCs to distribute patient medications
     - (3) While the ASHP survey results showed that only 22% of hospitals in 2002 employed ADCs as the primary method of drug distribution, by 2011 this figure had increased significantly to include 63% of hospital respondents
   - c. The rationale behind the wide acceptance of this technology may include
     - **Improved pharmacy productivity:** The use of ADCs may promote streamlining of the pharmacy dispensing process due to the reduced number of steps from filling each patient's individual medication bin to filling a centralized station. It also has the potential to reduce time needed to obtain missing medications
     - **Potential to enhance nursing productivity:** In a study that was designed to assess how nurses spend their time, nurse location and movement, and nurse physiologic response, approximately two-thirds of all time spent on medication administration was related to drug delivery to the patient (46.7 minutes). The other third (24.9 minutes) was spent preparing drugs for administration. The authors concluded that process improvements could reduce the time required for this step. Therefore, the time spent gathering or obtaining missing medications could be reduced with an automated decentralized drug distribution model using ADCs. Also, the turnaround time in obtaining newly ordered medications may be decreased
     - **Improved charge capture:** ADCs that are interfaced with the accounting department allow for the capture of all patient charges associated with administered medications
     - **Automated inventory control:** ADCs that utilize barcode technology can interface with the wholesaler for improved inventory control. In addition, the use of barcode technology increases the accuracy and efficiency of the ADC stocking process
     - **Improved security of controlled substances:** ADCs can be used to comply with regulatory requirements by tracking the storage, dispensing, and use of controlled substances
     - **Timelier drug availability:** ADCs can speed up delivery time for first and stat doses. In fact, a study found that storing key antibiotics in the ED ADC can significantly reduce order-to-antibiotic time and increase the percentage of severely septic patients receiving antibiotics within the recommended 3 hours from arrival to the ED
     - **Enhanced patient quality and safety:** ADC systems often allow for organization-specific, user-generated alerts to prevent medication errors such as warnings related to potential errors associated with high-alert medications and with look-alike/sound-alike medication names
   - d. However, such systems cannot improve patient safety unless cabinet *design* and *use* are carefully planned and implemented to eliminate opportunities for wrong drug selection and dosing errors
     - (1) According to the PSA, nearly 15% of all medication error reports cited ADCs as the source of the medication, and 23% of those reports involve high-alert medications
     - (2) Many of the reports described cases in which the design and/or use of ADCs had contributed to the errors
     - (3) The types of errors reported included wrong drug errors, stocking/storage errors, and medications being administered to patients with a documented allergy
   - e. Some documented unsafe practices with the use of these devices include **the lack of pharmacy screening of medication orders prior to administration**, which negates an independent double-check of the original order
     - (1) In the aforementioned ASHP survey conducted in 2011, 96.2% of hospitals had ADCs that used patient-specific medication profiles, which limits user access to those medications with active orders for the specified patient after the order has been reviewed by the pharmacist
     - (2) However, of those hospitals that used patient-specific profiles with their ADCs, it is estimated that 12.2% of medications are dispensed as overrides

(the manual action taken to counteract or bypass the normal operation)

(3) Unless a situation is emergent (in which waiting for a pharmacist to review the order before accessing the medication could adversely impact the patient's condition) medication orders should be screened by the pharmacy for

- **i.** Appropriateness of the drug, dose, frequency
- **ii.** Route of administration
- **iii.** Therapeutic duplication
- **iv.** Real or potential allergies or sensitivities
- **v.** Real or potential interactions between the prescription and other medications, food, and laboratory values
- **vi.** Other contraindications prior to removal from the ADC

(4) This is particularly problematic when medications, which are considered "high-alert," are removed on override in these devices[1]

Teaching Tip
Refer to Table 30.1.

Teaching Tip
Provide the example, in a medication error submitted to ISMP that occurred in a small hospital after the pharmacy was closed, an order was written for "calcium gluconate 1 g IV." The nurse, however, misread the label and believed that each 10 mL vial contained only 98 mg. Thus, she thought she needed 10 vials when actually each mL contained 98 mg, or 1 g/10 mL vial. A 10-fold overdose was avoided because the drug cabinet contained only six vials of calcium gluconate. Fortunately, this error was detected when the nurse contacted a pharmacist at home to obtain additional vials.

f. **Choosing of the wrong medication from an alphabetic pick list** is a common contributing factor in medication errors, which arises from medication names that look alike

Teaching Tip
Provide the example, in a report submitted to ISMP, one organization described three errors regarding mix-ups between diazepam and diltiazem removals from ADCs in their ICUs. In one case, diazepam was given at the ordered diltiazem dose and, in another case, a physician noted the amber color of the diazepam vial as the nurse was drawing up the dose (meaning to obtain diltiazem). The organization concluded that once the wrong drug was chosen, the cabinet seemed to "confirm" that the correct drug was selected since the nurse assumed the correct drug was chosen from the menu and thought the correct drug was in the drawer that opened. The nurse "relied" on her ability to choose the right drug from the pick list.

g. Medications, especially high-alert drugs, placed, stored, and returned to ADCs are problematic

(1) The process of placing and restocking medications into an ADC is primarily a pharmacy function

(2) Unfortunately, studies have indicated that an independent double-check (one individual supplies the cabinet with the medication and a second individual independently checks that the correct medication was placed into the appropriate location) does not always occur

(3) In the 2011 ASHP survey, 86.5% of the hospitals with ADCs had pharmacists check the accuracy and integrity of the medications in the ADC either before or after they are stocked

(4) A significant advance in the safe use of ADCs is the incorporation of barcode technology, which can effectively increase the accuracy of the ADC medication replenishment process

(5) This survey also showed that 43% of hospitals use barcode technology when loading ADCs

(6) Scanning medications when stocking ADCs can minimize the possibility of pharmacy staff placing medications in the incorrect pocket

Teaching Tip
Provide the example, in a case reported to ISMP, a patient had orders for both MS Contin (morphine sulfate controlled release) 15 mg tablets and for morphine sulfate immediate release 15 mg tablets. A pharmacy technician loaded both medications in the ADC in the patient care unit. The person loading the medications inadvertently loaded the MS Contin in the pocket for the morphine sulfate immediate release and the morphine sulfate immediate release in the pocket for the MS Contin. Some doses of each medication were actually administered to a patient. Fortunately, the patient suffered no apparent adverse effects from this incident. A second nurse discovered the error when removing the medication for the next dose.

Teaching Tip
Provide the example, another report involved the need to refill unit stock in an ADC with furosemide 40 mg/4 mL. A pharmacy technician selected what was thought to be vials of furosemide 40 mg/4 mL from the stock in a satellite pharmacy and then, without a pharmacist double-check, left the pharmacy and filled the ADC. A nurse on the unit went to the cabinet to fill an order for furosemide 240 mg. She obtained six vials out of the ADC and drew them into a syringe. After drawing up the sixth vial, the nurse noticed a precipitation. At that point, the nurse checked the vials to find that she had five vials of furosemide 40 mg/4 mL and one 5 mL vial of phenylephrine 1%. Both these medications were available in the same size amber vials with very little color or marking differentiation. These types of errors may have been avoided if barcode scanning technology had been utilized in the ADC refilling process.

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[1] High-alert medications can be defined as medications that, when involved in medication errors, have a high risk of injury or death. There is no documentation that the occurrence of medication errors is more common with high-alert medications than with the use of other drugs but the consequence of the error may be far more devastating (Cohen, 2007). Examples of high-alert medications can be found in Table 30.1

h. **Storage of medications with look-alike names and/or packaging** next to each other in the same drawer or bin is a contributing factor of errors involving ADCs
  - **(1)** A common cause of these mix-ups is what human factors experts call "confirmation bias," where a practitioner reads a drug name on an order or package and is most likely to see that which is most familiar to him, overlooking any disconfirming evidence
  - **(2)** Also, when confirmation bias occurs, it is unlikely that the practitioner would question what is being read
  - **(3)** This can occur both in the restocking process of the ADC and in the removal of medications

Teaching Tip

Provide the examples, one example includes a situation where a physician asked for ePHEDrine, but a hurried nurse picked EPINEPHrine from the ADC, drew up the medication into a syringe and handed it to the primary nurse who administered the EPINEPHrine. The patient suffered a period of hypertension and chest pain, but eventually recovered.

In another example, a prescriber wrote an order for morphine via a patient-controlled analgesia (PCA) pump. The nurse used the override function to remove a PCA syringe containing meperidine from the ADC. When pharmacy reviewed the override medication removal report the next morning, the error was discovered. The PCA pump still had the meperidine cartridge in place, but the pump settings were for morphine, resulting in an inappropriate dose. An example that made national news involved three premature infants who died in a Midwestern hospital after receiving an overdose of heparin. Vials of heparin 10,000 unit/mL 1 mL were placed incorrectly into a unit-based ADC where 1 mL, 10 units/mL vials were normally kept. Several nurses requested 10 unit/mL vials to prepare an umbilical line flush and were directed to that drawer, but did not notice that the vials contained the wrong concentration.

i. Another important improvement in the safety of ADCs is the use of lidded pockets, which can minimize the risk of these types of stocking and selection errors
  - **(1)** Lidded pockets restrict access to only the medication selected, thereby minimizing the possibility of picking a medication from the wrong pocket, taking other doses than the one needed for a specific patient, or having the pharmacy staff to load or return medications to the wrong pocket
  - **(2)** The 2011 ASHP national survey found that 62% of hospitals utilized ADCs with lidded pockets

j. **The development of "workarounds"** for ineffective or inefficient systems can be devastating to patient safety
  - **(1)** The interaction between a nurse and technology is very important and often is not considered when various forms of automation, including ADCs, are purchased, installed, and employed on the nursing unit
  - **(2)** When the device does not respond as expected, nurses often find various ways of working around the system to obtain medications
  - **(3)** In the PCA medication selection error discussed above, overrides were established by the organization that allowed nursing to obtain certain medications without review by a pharmacist
  - **(4)** Overrides usually are needed with medications used in emergency situations
  - **(5)** Unfortunately, when overused, overrides also serve as an "extended" pharmacy in order to obtain and administer medications prior to verification by the pharmacy
  - **(6)** One study involving the use of an expert panel who developed criteria for override access and revised the override medication list, showed a reduction in the number of medications and dosage forms on the override list by 42% (from 119 different medications in 244 different dosage forms to 92 different medications in 163 different dosage forms), resulting in a significant decrease in opioid override rates

k. Additional error reports involving workarounds include the removal of medications using the inventory function (used to determine the number of doses on hand of a particular medication) to obtain medications for patients without pharmacy screening, removal of a larger quantity of medications than ordered for one patient, and removal of medications for multiple patients while the cabinet is open

l. In spring 2007, ISMP convened a national forum of stakeholders to create interdisciplinary guidelines for ADCs
  - **(1)** These associated core processes are intended to be universally incorporated into practice in an effort to promote safe ADC use and subsequently improve patient safety
    - **Provide ideal environmental conditions for the use of ADCs.** The physical environment in which the ADC is placed can have a dramatic effect on medication errors. Specifically, the work environment and a busy, chaotic work area were cited as the top two contributing factors in medication errors
    - **Ensure ADC system security.** Security processes must be established to ensure adequate control of medications outside of the pharmacy and to reduce the potential for medication diversion from ADCs
    - **Use pharmacy-profiled ADCs.** The use of a "profiled" ADC allows the pharmacist to clinically review new drug orders for appropriateness prior to the medication being accessed by the nurse or other healthcare professional
    - **Identify information that should appear on the ADC screen.** Having sufficient patient information and drug information when dispensing and administering medications is key to the safety of the medication use process. Because there is limited space available on the ADC screens, it is important to focus on presenting the information that is of the greatest value to practitioners, allowing for the clear identification of specific patients, their active medication profiles, and supporting information for safe drug use
    - **Select and maintain proper ADC inventory.** The ADC inventory should be determined based on the needs of the patient population served and replenished on a regular schedule. Medications should be routinely reviewed and adjusted considering medication prescribing patterns, drug utilization, and specific unit needs (taking into account typical patient ages and diagnoses). Standard stock medications should be identified, and approved, for each

patient care area, with the goal to limit the variety of drug concentrations, avoid bulk supplies, and provide medications in ready-to-use unit doses

- **Select appropriate ADC configuration.** Restricting access to medications limits the potential for inadvertently selecting the wrong medication. Medications stocked in ADCs may be high alert or high cost, and it is important to ensure that only the right drug is selected. For these reasons, it is important to maximize the use of high-security drawer configurations such that each drug has its own unique and segregated location within the ADC, and so access is limited to only the specific drug needed
- **Define safe ADC restocking processes.** The restocking process encompasses a number of subprocesses that can involve both pharmacy and nursing staff. It is important that the process contain redundancies to ensure that the correct medication is placed in the correct location within the ADC. It is also important that the process be defined and organized so staff involved can only follow the correct pathway and the potential for process variation is limited. Consider systems that utilize barcode scanning technology during stocking, which can minimize the risk of misplacement errors
- **Develop procedures to ensure the accurate withdrawal of medications from the ADC.** Processes must be developed that reduce the risk or mitigate the harm associated with the administration of the wrong medication, dose, route, or frequency due to ADC medication retrieval errors. Of particular importance is the ability and expectation for the nurse to access the medication administration record when selecting medications from the ADC. In addition, the contents (variety, concentrations, and volume) and configuration of the ADC play a large role in the practitioner's ability to safely select and remove medications from the ADC
- **Establish criteria for ADC system overrides.** Use of ADC overrides should be situationally dependent, and not based merely on a medication or a list of medications. Criteria for system overrides should be established that allow emergency access in circumstances in which waiting for a pharmacist to review the order before accessing the medication could adversely impact the patient's condition. Routinely run and analyze override reports to help track and identify problems
- **Standardize processes for transporting medications from the ADC to the patient's bedside.** A process should be developed that reduces the risk of medications being administered to the wrong patient at the wrong time during the transportation of medications from the ADC to the patient. Supporting safety may require the availability of additional ADCs or the placement of ADCs in strategic locations to prevent workarounds. Not having sufficient ADCs, or having them located far from patient rooms, fosters the at-risk behavior of taking medications for more than one patient at a time or taking medications for more than one scheduled administration time. The safety of this practice also is impacted by the organization's ability to secure medications during transport between the ADC and the patient's bedside
- **Eliminate the process for returning medications directly to their original ADC location.** Instead, return all medications to a common, secure one-way return bin that is maintained by pharmacy, not to an individual pocket or bin within the ADC. Occasionally practitioners inadvertently return medications to the wrong pocket, either because of user distraction, look-alike and sound-alike medications in a matrix bin, or a slip in procedure
- **Provide staff education and competency validation.** All ADC users must be educated and have regular competency validation in the proper operation of the device in order to meet expectations for safe use. Most often this education occurs during the practitioner's orientation period, or upon ADC installation, but an annual update may be required in order to ensure ongoing appropriate use. Users who are not properly oriented to the device may develop practice habits and device workarounds that are considered unsafe

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Smart Infusion Pump Delivery Systems

1. Overview
    - **a.** Infusion pumps are primarily used to deliver parenteral medications through IV or epidural lines and can be found in a variety of clinical settings ranging from acute-care and long-term care facilities, patient's homes, and physician's offices
        - **(1)** Among ADEs, the significant potential for patient injury and death related to IV medication errors is well-known
    - **b.** A study conducted in an academic medicosurgical ICU found that up to 21 separate errors might have occurred in association with a single dose of an IV medication, and one of the most common occurring errors related to a discrepancy between the medication order as recorded in the patient's chart and the IV medication that was being infused
    - **c.** An Australian study designed to identify the prevalence of medication administration errors and their related causes found that errors in the administration of continuous IV infusions occurred in almost one out of five infusions, and the most common error (79.3%) was wrong administration rate
    - **d.** Adachi and Lodolce showed that the most common reason for the administration of wrong doses of IV medications was an error in programming IV infusion pumps (41%), and this step in the medication-use process was associated with the highest impact
    - **e.** Husch and colleagues examined IV administration errors specifically associated with IV pumps and of the 426 medications observed infusing via an IV pump, 66.9% had one or more errors related to their administration

f. The causes of these IV administration errors were diverse in nature

g. In addition, Pettus and Vanderveen warn that a single wrong keystroke when programming an infusion pump can result in a 10- or 100-fold overdose with tragic results, further calling it "death by decimal"

(1) Highlighting these concerns, ECRI (a nonprofit organization that evaluates medical device safety) announced that medication administration errors using infusion pumps placed second on its annual list of Top 10 Health Technology Hazards for 2013

(2) Conversely, infusion pumps with dose error reduction software (DERS), often referred to as smart pumps, can reduce medication errors, improve workflow, and provide a new source of data for continuous quality improvement by identifying and correcting these pump-programming errors

h. The administration of parenteral medications has traditionally been based on a calculation of a volume to be infused per hour of delivery

(1) Infusion pumps are capable of delivering a wide range of delivery rates, ranging from 0.01 mL/hour to as much as 1 L/hour, which could result in the device being programmed all too easily in error to deliver a 10- or 100-fold overdose

Teaching Tip

Provide the example, one such error reported to ISMP occurred when a nurse attempted to program an infusion pump for a baby receiving parenteral nutrition (PN) by inputting 13.0 mL/hour. The decimal point key on the pump was somewhat worn and difficult to engage. Without realizing it, the nurse programmed a rate of 130 mL/hour. Fortunately, the error was discovered within 1 hour. The baby's glucose rose to 363, so the rate of the PN infusion was decreased for a period of time and the infant then stabilized.

i. Confusion with dosing nomenclature has been another source of error

(1) A medication may be inadvertently programmed to be administered as micrograms per kilogram per minute (mcg/kg/min) instead of micrograms per minute (mcg/min), a 24-hour dose may be delivered over 1 hour, or a missing decimal point or an additional zero may result in a 10-fold overdose. Infusion pumps are specifically designed to have maximum flexibility, so they can be used in multiple areas of the facility

(2) Consequently, a pump used today for a 200-kg patient in the adult ICU may also be used on a 3-kg infant in the ED

j. In other cases, mis-programming of a medication's concentration has resulted in significant error

Teaching Tip

Provide the example, one such example involved HYDROmorphone 20 mg/100 mL (0.2 mg/mL) intended to be infused at 2.5 mg/hour. For the institution, this was a custom concentration and required programming of the infusion as volume over time instead of selecting the concentration from the smart pump drug library. When programming the pump, the nurse mistakenly entered 2.5 mg/100 mL as the concentration instead of 20 mg/100 mL. Based on the incorrect programming, the pump delivered the medication at a rate of 100 mL/hour instead of 12.5 mL/hour. The entire 20 mg bag of HYDROmorphone was delivered to the patient in 1 hour. The outcome of this patient is unknown (ISMP, 2012). Other programming errors have resulted in additional monitoring and medical intervention. For example, a heparin infusion 25,000 units/250 mL was dispensed from the pharmacy in a concentration that was available in the smart pump library. However, the nurse selected the custom concentration option erroneously entering 800 units/250 mL. The ordered dose of 800 units/hour should have infused at 8 mL/hour, but instead infused at 250 mL/hour. The patient received the entire bag in 1 hour and required treatment with IV protamine.

(1) The common denominator in many of these and other cases was a single wrong entry or button pressed. The use of a smart infusion pump, programmed with patient and drug parameters, provides the ability to recognize an error before the infusion even begins

(2) In a study to assess the impact of infusion pump technologies, comparing traditional infusion pumps with smart pumps, the number of nurses who remedied "wrong dose hard limit" errors was higher when using the smart pump (75%) than when using the traditional pump (38%)

k. The introduction of smart infusion technology has changed the paradigm of infusion therapy by removing the reliance on memory and human input of calculated values to a software-enabled filter to prevent keystroke errors in programming infusion devices for delivery of parenteral medications

(1) Smart pumps can include

i. Comprehensive libraries of drugs

ii. Usual concentrations

iii. Dosing units (e.g., mcg/kg/min, units/hour)

iv. Dose limits

v. Software that incorporate institution-established dosage limits, warnings to the practitioner when dosage limits are exceeded, and configurable settings by patient type or location in the organization (i.e., ICU, pediatric ICU [PICU])

(2) Such systems make it possible to provide an additional verification at the point-of-care to help prevent medication errors

l. Current smart pump software enables the infusion system to provide an additional verification of the programming of medication delivery

(1) The user receives an alert when the dose is below or above the organization's preestablished limits

(2) The limits can be set as either "soft" (can be overridden) or "hard" (one that will not let the nurse go any further without reprogramming the pump)

(3) The drug library in the system generally requires the practitioner to confirm the

i. Patient care area

ii. Drug name

iii. Drug amount

      - **iv.** Diluent volume
      - **v.** Patient weight (as appropriate)
      - **vi.** Dose
      - **vii.** Rate of infusion
    - **(4)** The system can allow organizations to configure unit-specific profiles, which include
      - **i.** Customized sets of operating variables
      - **ii.** Programming options
      - **iii.** Drug libraries
- **m.** Although not widely available at the present time, smart infusion systems could also incorporate barcode technology to advance the safe programming of IV medications
    - **(1)** Specifically, IV interoperability is a process which integrates the eMAR, BCMA, and smart pump into a barcode-driven workflow
    - **(2)** This technology automatically populates the smart pump with the pharmacy verified, provider order
    - **(3)** In addition, it allows infusion-specific data from the smart pump to be electronically recorded in the eMAR at the time of administration
    - **(4)** One study found that the integration of IV interoperability reduced medications errors, involved pharmacists in checking infusion rates, and simplified nursing workflow
- **n.** Another significant benefit associated with smart pump technology is the ability to access transaction data from the infusion device for quality improvement efforts
    - **(1)** Continuous quality improvement logs in the software record the close calls (programming errors) averted by the system
    - **(2)** Practitioners can use this data to assess current practices and identify ways of improving safe use of medications
    - **(3)** For each safety alert, a record can be generated with the
      - **i.** Time
      - **ii.** Date
      - **iii.** Drug
      - **iv.** Concentration
      - **v.** Programmed rate
      - **vi.** Volume infused
      - **vii.** Limit exceeded
      - **viii.** Clinician's response to the warning (i.e., continue at the current settings or change the programming)
    - **(4)** Similar data for infusions delivered with traditional settings for rate and volume can also be captured, along with other transactional data generated as a result of pump use (e.g., alarms, air in line)
    - **(5)** Thus, the system can be used to show whether potential infusion errors were detected and to assess current practice to determine if improvements can be made to optimize care and reduce costs
- **o.** Documented examples of errors prevented using smart pump technology have been published

Teaching Tip

Provide the example, in an event reported to ISMP, a physician in the ED wrote an order for Integrilin (eptifibatide) but inadvertently prescribed a dose appropriate for ReoPro (abciximab). The Integrilin infusion was initiated and continued for approximately 36 hours after the patient was transferred to a medical/surgical unit. During this time, the patient's mental status was deteriorating. Coincidentally, at that time, the hospital was switching to a smart pump infusion system. As the nurse was transferring the infusion parameters from the old infusion system to this new system, safety software incorporated in the device alerted the nurse that there was a "dose out of range." The pump would not allow the nurse to continue until a pharmacist was called and the mistake was corrected. In another case, a hospital's heparin protocol called for a loading dose of 4000 units followed by a constant infusion of 900 units/hour. The loading dose was administered correctly, but the nurse inadvertently programmed the continuous dose as 4000 units/hour. Since the pump limit for heparin as a continuous infusion was set at 2000 units/hour, the infusion device would not start until the dose was corrected. In both cases, these mistakes may have gone undetected without preprogrammed limits and patient harm might have resulted.

- **p.** Smart pump technology is also not without limitations
    - **(1)** If the smart pump drug library is bypassed, and the infusion rate and volume is manually entered, the DERS will not be in place to prevent a potential error
    - **(2)** Engaging in this at-risk behavior reduces the likelihood that an error will be identified since no alerts will be triggered
    - **(3)** In a prospective, randomized time-series trial, Rothschild and colleagues noted that IV medication errors were frequent and could be detected using smart pumps
    - **(4)** The authors found no measurable impact on the serious medication error rate with smart infusion pumps, likely in part due to poor compliance
    - **(5)** Violations of infusion practice during the intervention periods included bypasses of the drug library (25%)
    - **(6)** Numerous events have been reported to the PSA that include examples of errors associated with the use of smart infusion pumps

Teaching Tip

Provide the examples, include similar types of errors that may occur with the use of general infusion pumps:

- Organizations that did not standardize the concentrations of high-alert medications
- Practitioners inadvertently switching IV lines between separate infusion pumps or dual-chambered infusion pumps
- Wrong-dose errors when inaccurate patient weights were used to calculate and program weight-based doses
- Inadvertent selection of a wrong drug or the wrong unit of measure in the smart pump's library

q. Thus, prior to implementation, it is important to use proactive approaches such as FMEA and clinical simulations to identify potential clinical practice issues and risk of error with IV drug administration utilizing smart infusion pumps

   (1) Implementation should be coordinated by a multidisciplinary team (including frontline nurses) that can determine best practices

   (2) This team should institute changes in policies and procedures that reflect the installation of smart infusion technology. Asking a nurse to choose from among many concentrations, dosing units, or remembering several possible drug names will increase the risk of error with smart pump use

   (3) Therefore, standardization of IV-related policies and procedures, standardization of concentrations, dosing units (e.g., mcg/min vs. mcg/kg/min) and drug nomenclature is essential

   (4) These items should be consistent with those used on the MAR, CPOE system, pharmacy computer system, EMR, and pharmacy labels, if applicable

r. Many drug references provide information on the maximum dose over a 24-hour period, but do not provide the minimum and maximum doses that can be administered over 1 hour, so the team should develop dosage limits for infusions and boluses based on current policy and practice, the literature, and common references used in medical practice

   (1) In addition, there needs to be a determination of which dose limits require a "soft" or a "hard" stop

   (2) Existing best practices and policies and unit-based dosage limits should then be used to develop data sets based on patient care areas, for example

      i. Adult ICU
      ii. Adult general care
      iii. NICU
      iv. PICU
      v. Pediatric general care
      vi. Labor and delivery
      vii. Anesthesia

   (3) Different configurations can be created for each area

   (4) It will also be important to include a procedure for the nursing staff to follow in the event a drug must be given which is not in the library or if a nonstandardized concentration must be used, should be created

   (5) Lastly, there must be a clear expectation for staff to maximize the use of the DERS to fully realize the safety benefits of this technology

s. Utilizing a well-planned, multidisciplinary approach to smart pump implementation which maximizes the use of the DERS has the potential to significantly reduce IV medication administration errors and patient harm

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Implementation of Technology

1. Overview

a. Implementing any form of technology in a healthcare organization can be an imposing task

   (1) Many organizations have purchased various forms of automation, with little or inadequate planning and/or preparation, which can lead to errors as well as the development of serious problems

   (2) Therefore, it is vitally important to thoroughly plan for necessary workflow changes and to remember your goal is to improve clinical processes, which can be facilitated by technology

   (3) Foremost, the process will require total commitment from the organization's executive and medical leadership as well as all staff members who will be affected by the implementation

   (4) It is essential that leadership sends a clear message that the new technology is important to patient safety and that they provide their unwavering support and financial backing as the project evolves

   (5) Providing this level of commitment will greatly increase the success of the project

b. Identifying physician champions at a very high level in the organization is crucial and involving them in the decision making and planning process will help to persuade practitioners to "buy into" technology

   (1) In addition, an interdisciplinary team of key individuals who can collaborate on an effective and realistic plan for implementation should be organized to provide ongoing project direction and oversight

   (2) Important key players include the chief information officer, information technology, risk managers, medical staff, frontline practitioners, and other support staff who may interact directly with the technology

   (3) The multidisciplinary implementation team will need to address the following issues

      - Outline goals for the type of automation to be implemented (e.g., to improve safety, decrease costs, eliminate handwritten orders). Consider identifying primary and secondary goals
      - Develop a wish list of desired features and determine which, given budgetary constraints, are practical
      - Investigate systems that are presently available. Find out about successes and failures by talking with or visiting individuals from other organizations who have implemented similar systems. Determine whether the new system will interface with your current information systems and to what extent customization will be required
      - Analyze the current workflow and determine what changes are needed. This may include any changes that will occur in the current processes as well as the organizational culture. A lack of fit with clinical process and practice can be a downfall because healthcare practitioners tend to resist process changes that produce inefficiencies, complicate their work, or do not provide clear benefits

- Policies and procedures for both the implementation and ongoing use must be defined prior to rollout. There will be numerous workflow changes that must be carefully planned to address the multiple operational transitions during the rollout such as when:
    - Each care area transitions from a paper-based system to an automated system
    - Patients are transferred from the automated units to areas with no automation
    - Healthcare providers move from areas with automation to areas without automation
- Identify the required capabilities and configuration of the new system. If the system allows for the creation of rules, protocols, guidelines, or drug dictionaries, individuals that will be affected by these changes need to develop these items before the system is implemented
- "Sell" the benefits and objectives of automation to staff. Do not try to justify the new system by promising that it will allow the institution to decrease the number of staff members, because it most likely will not. A good system, though, should enhance safety and improve efficiency by decreasing the number of repetitive and mundane tasks. You may see the number of steps in the medication-use process decrease, but the remaining steps will require highly educated, competent personnel who understand and can deal with the complexity and importance of those steps
- Develop an implementation plan. Set realistic timeframe expectations. Extensively test the system for accuracy and safety before implementation. Focus on efficiency and safety. Healthcare practitioners will not use a system, which is perceived as less efficient than the existing system

c. Once the system has been implemented within the organization, there are still many issues that need to be considered

(1) Plan on many years of system development and enhancement after the product is initially piloted

(2) As soon as the system is installed, it is important to commit in a meaningful way to its continual monitoring and improvement

(3) The healthcare environment is a dynamic one in which opportunities for new and different errors with technology will likely arise

(4) Identify key measures that will help you determine whether your systems are really improving safety and quality and reducing costs

(5) Beware of cumbersome features that may provoke users to override features or develop workarounds with the system

(6) Finally, do not be discouraged by initial dissatisfaction among staff members, and do not interpret initial negative reactions as failures

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- Nurses have the responsibility to become familiar with the availability of "safety" technology, its advantages and disadvantages, and to work in collaboration with other healthcare stakeholders in the search for new and innovative technologic solutions to improve patient safety.

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe factors that will influence the adoption of technology in healthcare
- Describe the challenges and rewards related to implementing a computerized prescriber order entry system (CPOE)
- Recognize the benefits and limitations of barcode-assisted medication administration (BCMA) technology as it relates to overall efforts to reduce medication errors, including errors using these systems
- Define the benefits and limitations of automated dispensing cabinets (ADCs) in healthcare and their application to the medication-use process
- Describe the benefits and limitations of smart infusion pump technology
- Recognize the value of and a methodology for assessing an organization's readiness for implementing technology

Teaching Tip
Ask the students to define the keywords

- Automated dispensing cabinet
- Barcode-assisted medication administration technology
- Computer prescriber order entry
- Failure mode and effects analysis
- High-alert medications
- Medication error
- Smart infusion pump delivery systems

CHAPTER REVIEW QUESTIONS

Question 30.1: Name a form of technology that results in reduced medication errors.

a. One form of technology that will have a great impact on medication safety during the administration process is barcode-assisted medication administration (BCMA) technology

b. One form of technology that impacts on medication safety is the use of clinical practice guides

c. One form of technology that impacts on medication safety is the personal health record

d. One form of technology that impacts on medication safety is the patient portal

Question 30.2: What type of technology has an impact on medication errors from illegible orders, the healthcare practitioner's workflow is typically interrupted?

a. The BCMA
b. The personal health record
c. The patient portal
d. The CPOE

Question 30.3: Name three factors influencing adoption of safe medication use in the United States.

a. Consumers have become increasingly concerned that hospitals are less than safe following the numerous mass media reporting of medical mistakes
b. The Leapfrog Group, composed of more than 150 private and public organizations providing healthcare benefits, this group felt that they had a significant financial investment in preventing errors
c. The announcement by the Centers for Medicare and Medicaid Services (CMS) of a proposed rule to implement provisions of the American Recovery and Reinvestment Act of 2009 (Recovery Act) that provide incentive payments for the meaningful use of certified electronic health records (EHR) technology
d. All of the above

Question 30.4: Which agency of the government recommended barcode administration?

a. The AHRQ
b. The NIH
c. The CDC
d. The FDA

Question 30.5: What was one of the first healthcare facilities to adopt barcode administration?

a. The NIH
b. The large academic medical centers in Boston
c. The small rural healthcare facilities in the southwest
d. The VA Healthcare Facilities

Question 30.6: What are the benefits of automated dispensing cabinets (ADCs) in healthcare?

a. Improved pharmacy productivity, potential to enhance nursing productivity, improved charge capture, automated inventory control, improved security of controlled substances, timelier drug availability, and enhanced patient quality and safety
b. Improved quality, effectiveness, and efficiency of patient care
c. Reduced costs to medication delivery
d. None of the above

Question 30.7: What is a potential cause of unsafe use of automated dispensing cabinets (ADCs)?

a. Unsafe practices with the use of ADCs include the fact that no one can find the keys to the cabinets in the healthcare facility
b. Unsafe practices with the use of ADCs occur when he nurse forgets the sign in and password
c. Unsafe practices with the use of ADCs include the lack of pharmacy screening of medication orders prior to administration, which negates an independent double-check of the original order
d. Unsafe practices cannot occur with the use of automated dispensing cabinets

Question 30.8: True or False. "Workarounds" for ineffective or inefficient systems can be devastating to patient safety.

Question 30.9: Guidelines for the use of the ADCs include all but the following:

a. Provide ideal environmental conditions for the use of ADCs
b. Do not ensure system security
c. Identify information that should appear on the ADC screen
d. Select and maintain proper ADC inventory

Question 30.10: What are common errors from general infusion technology?

a. No human or technological errors can occur with infusion technology
b. Only errors associated with integration with the EHR and documentation reporting are known to occur
c. Errors that may occur with the use of general infusion pumps: Organizations that did not standardize the concentrations of high-alert medications, practitioners inadvertently switching IV lines between separate infusion pumps or dual-chambered infusion pumps, wrong-dose errors when inaccurate patient weights were used to calculate and program weight-based doses, and inadvertent selection of a wrong drug or the wrong unit of measure in the smart pump's library
d. Errors that may occur with the use of general infusion are not reported to any government or private sector organization and they go undetected

ANSWERS AND EXPLANATIONS

Question 30.1: (a) One form of technology that will have a great impact on medication safety during the administration process is barcode-assisted medication administration (BCMA) technology.

Question 30.2: (d) The CPOE is the type of technology that has the potential to alleviate illegible orders, and the healthcare practitioner's workflow interruptions.

Question 30.3: (d) All of the above. Consumer interest in media announcement, the Leapfrog Group, and CMS MU in EHR.

Question 30.4: (d) Interest in the use of barcoding technology increased due to the Food and Drug Administration's (FDA's) February 25, 2004 ruling, which required medications to have machine-readable barcodes.

Question 30.5: (d) One of the first healthcare facilities to adopt barcode technology was due to the inspiration of a nurse at the Department of Veterans Affairs (VA) in Topeka, Kansas. Her insight resulted in a 74% improvement in errors caused by the wrong medications being administered, a 57% improvement in errors caused by incorrect doses being administered, a 91% improvement in wrong patient errors, and almost a 92% improvement in wrong time errors between 1993 and 1999.

Question 30.6: (a) Improved pharmacy productivity, potential to enhance nursing productivity, improved charge capture, automated inventory control, improved security of controlled substances, timelier drug availability, and enhanced patient quality and safety.

Question 30.7: (c) Unsafe practices with the use of ADCs include the lack of pharmacy screening of medication orders prior to administration, which negates an independent double-check of the original order.

Question 30.8: True. "Workarounds" for ineffective or inefficient systems can be devastating to patient safety.

Question 30.9: (b) ADC system security should be ensured. Security processes must be established to ensure adequate control of medications outside of the pharmacy and to reduce the potential for medication diversion from ADCs.

Question 30.10: (c) Errors that may occur with the use of general infusion pumps: Organizations that did not standardize the concentrations of high-alert medications, practitioners inadvertently switching IV lines between separate infusion pumps or dual-chambered infusion pumps, wrong-dose errors when inaccurate patient weights were used to calculate and program weight-based doses, and inadvertent selection of a wrong drug or the wrong unit of measure in the smart pump's library (PSA, 2007).

31

The Magnet Model

• OBJECTIVES

1. Identify the five components of the ANCC Magnet Model.
2. Describe how technology has influenced the professional practice environment.
3. Describe some ways nursing informatics as a specialty can support the achievement of magnet standards and emerging demands of professional practice.

• KEY WORDS

Transformational leadership
Structural empowerment
Exemplary professional practice

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you explain a magnet? What are the properties of a magnet? How could the metaphor of a magnet be used in nursing and nursing informatics?

For a WIIFM statement, say to the class, "this chapter provides an introduction to the essential elements for excellence in professional nursing practice that are defined within the ANCC Magnet Recognition Program. The Magnet model defines five components which when fully disseminated and enculturated throughout the organization create professional practice environments that yield positive patient, nurse, and organizational outcomes. The five components are: ***transformational leadership, structured empowerment, exemplary professional practice, new knowledge and innovation, and empirical outcomes.*** The essential elements are described along with the structures and processes known to develop professional nursing practice as a core competency and contribute to patient and provider outcomes for organizational effectiveness. The Magnet Model informs nursing informatics practice to serve as a driver to practice excellence. Nursing informatics fully enculturated in the practice environment which supports development of high-performing nursing organizations, clinical practice in addition to, most importantly, supporting the ability to define, measure, and report outcomes at an individual, department, population, or organizational level. The information presented in the chapter will define the specific domains defined within the ANCC Magnet Recognition Program Magnet model and describe the influence and relationship between practice and informatics." As a nurse, it is important to understand the Magnet Model.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites related to the chapter content for more information

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   a. The nursing practice environment is being challenged to rapidly respond to internal and external demands
      (1) Value-driven, patient-centered healthcare outcomes across the continuum amidst the landscape of increasing complexity of care is the requirement for today's delivery systems
      (2) New models of care are emerging that require empirical, evidence-based accountable care
      (3) These new models will not be accomplished, without the use and integration of informatics to track and

    quantify cost of care, improve the process and workflows of care, and more transparently communicate outcomes of care
    - **(4)** Incorporating healthcare information technology and the expertise of nursing informatics into future models will assure patient care is safer, more efficient and effective, and promote excellence in nursing practice
    - **(5)** Nursing excellence is promoted and recognized through the American Nurses Credentialing Center (ANCC) Magnet Recognition Program
    - **(6)** The Magnet Commission has defined a vision for Magnet organizations to serve as the fount of knowledge and expertise for the delivery of nursing care globally by striving for discovery and innovation to lead the reformation of healthcare and the discipline of nursing
    - **(7)** Sources of evidence used to define and evaluate the organization's achievement of the magnet standards identifies informatics and technology as necessary components of the structures and processes to achieve the anticipated benefits
- **b.** Essential elements for excellence in professional nursing practice are defined within the ANCC Magnet Recognition Program
    - **(1)** The Magnet model defines five components that when fully disseminated and enculturated throughout organization create professional practice environments that yield positive patient, nurse, and organizational outcomes
    - **(2)** The five components are:
        - **i.** Transformational leadership
        - **ii.** Structured empowerment
        - **iii.** Exemplary professional practice
        - **iv.** New knowledge and innovation
        - **v.** Empirical outcomes

Teaching Tip
Refer to http://www.nursecredentialing.org/magnet/programoverview/newmagnet-model

    - **(3)** The essential elements are described along with the structures and processes known to develop professional nursing practice as a core competency and contribute to patient and provider outcomes for organizational effectiveness
    - **(4)** The Magnet Model informs nursing informatics practice to serve as a driver to practice excellence
    - **(5)** Nursing informatics fully enculturated in the practice environment supports
        - **i.** Development of high-performing nursing organizations
        - **ii.** Clinical practice
        - **iii.** In addition to most importantly, supporting the ability to define, measure, and report outcomes at an individual, department, population, or organizational level
    - **(6)** The following paragraphs will define the specific domains defined within the ANCC Magnet Recognition Program Magnet model and describe the influence and relationship between practice and informatics

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Transformational Leadership

1. Overview
- **a.** Transformational leadership can be defined in many ways
    - **(1)** The ANCC Magnet Model defines the transformational leader as one who develops a strong vision for the practice and creates an environment where nurses at every level have a voice to advocate for resources, fiscal, and technology, to support their practice
    - **(2)** The transformational nurse leader articulates a future vision where patient care is supported and accelerated through access to information and interoperability of the technology
    - **(3)** The patient care vision supports the alignment of people, process, and technology
    - **(4)** The leader is accountable to assure the provision of the highest quality of care, which positions the chief nurse executive to serve as the organization's executive project sponsor for the implementation of technology solutions and electronic health record
    - **(5)** Most importantly, the nurse leader is responsible for the strategic nursing platform, which requires reformation of our care delivery systems and relationships between and among providers, patients, and community
- **b.** A strategic vision for practice that is supported by informatics promotes the development of innovative approaches to care by improving the work of the nurse through improved access to information and opportunities and new ways for the nurse to communicate and interact with other providers and the patient
    - **(1)** The use of informatics science to drive the design of new models and roles for nursing practice requires a different set of skills and competencies for nursing leaders
- **c.** All health systems today are being influenced by the growth in technology
    - **(1)** One of the sources of evidence organizations must be able to demonstrate is the work of the nursing leader and department in strategic planning
    - **(2)** Specifically, how the nursing mission, vision, strategic, and quality plans align with the overall organization's strategic goals
    - **(3)** This plan must demonstrate the structure and processes used by nursing to improve efficiency and effectiveness
    - **(4)** Without the strong influence of informatics, organizations would struggle to meet this standard
    - **(5)** Many organizations use their strategic information technology initiatives as evidence of their effort in this aspect of the magnet standards

d. For organizations to achieve successful implementations of health information technology there must be leadership buy-in and sponsorship and engaged nurse executives
  (1) It is now widely acknowledged that the implementation of a clinical IT solution is a clinical project requiring the vision and commitment of clinical leadership
  (2) The nurse executive is a key stakeholder in the IT implementation to ensure the alignment with the strategic vision and plan for the professional nursing practice
  (3) In this role the nurse executive is also a champion to positively influencing acquisition, implementation, and adoption of IT within the organizations

e. The American Organization of Nurse Executives (AONE) has included informatics in its recent update of competencies for nursing executives
  (1) The competencies will support the application of informatics to create a new way of thinking and defining practice excellence
  (2) The competencies AONE has developed include guiding principles for nurse executives which serve as a tool for nurse executives as they engage in IT initiatives within their organization
  (3) AONE first addressed technology with the development of the AONE Guiding Principles for Defining the Role of the Nurse Executive in Technology Acquisition and Implementation
  (4) Advancing that work they also developed AONE Guiding Principles for the Nurse Executive to Enhance Clinical Outcomes by Leveraging Technology

f. The role of the Chief Nursing Informatics Officer (CNIO) has emerged to support and help to translate the science of informatics for all nursing roles
  (1) Associated with a specific set of standards for practice in the ANA Scope and Standards for Nurse Informatics, the CNIO role provides a partner to the role of the chief nurse executive
  (2) The partnership described by Swindle and Bradley describes an engagement between the roles where the CNIO provides direction and oversight for clinical informatics programs aligned with the vision for practice and operations led by the CNO
  (3) The area of informatics provides a dimension within our profession for ongoing professional development
  (4) The recognition of informatics as a dimension for professional growth and incorporation of informatics expertise into organizational structures will support the alignment of our people, processes, and technology
  (5) Through the effective alignment of practice, operational and informatics expertise and leaders, more creative and successful solutions to improve workflow, and process changes that improve communication and care coordination to improve outcomes

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Structural Empowerment and Exemplary Professional Practice

1. Overview
  a. The voice, autonomy, and decision-making authority of direct care nurses are at the core of the structural empowerment and exemplary professional practice components of the ANCC Magnet model
    (1) Structural empowerment is evidenced through flat, flexible organization where the flow of information is fluid between the bedside and leadership. Improvements in practice settings and nurses' involvement in decision-making groups are critical
  b. In defining shared governance structure organizations may choose to include informatics across various councils to ensure the efforts and activities evaluated by the council to consider how technology can play a supporting role
    (1) In others, the organization may additionally create an Informatics Council, including representation from multiple disciplines, where aspects of the IT implementation and adoption are reviewed and agreed upon
    (2) The involvement of nurses at all levels in these councils and the integration of information technology within the activities of the councils supports the key aspects of structural empowerment within the Magnet program
  c. Magnet organizations are required to demonstrate improvements in practice settings across the continuum that have occurred as a result of the use of data and information

Teaching Tip
Provide the examples of the use of technology to identify patients who are at risk for pressure ulcers, clinical summaries designed as hand-off tools, and alerts to ensure core measures are addressed in a timely manner. Selection and use of technology that support practice promote structure and process components defined in the magnet framework. The changes to workflow process that improve care support the evidence of how those structures and processes result in improved outcomes that can be measured and reported.

  d. Exemplary professional nursing practice within the magnet framework is supported through a professional practice model and care delivery system that delineate the role of the nurse as a fully accountable provider responsible for care that is patient-centered, safe, effective, efficient, and equitable
    (1) Interdisciplinary collaboration within magnet facilities demonstrates the need for collegial and respectful alignment of all disciplines focused on the needs of the patient
    (2) This requires new methods to support interdisciplinary planning, communication, and coordination
    (3) In addition, this will require the effective use of information systems and technology to support clinical care planning, execution, and documentation
    (4) The effective use of informatics to improve interdisciplinary care communication and coordination, positions the care team to respond to the growing need to increase patient involvement in their own care

- **e.** At the core of achieving exemplary professional nursing practice is the ability to monitor care for effectiveness by having access to data to analyze and evaluate against national benchmarks and respond to improvement
    - **(1)** There are standards designed to evaluate how nurses investigate, develop, implement, and systematically evaluate standards of nursing practice
    - **(2)** This requires evidence that nurses are using a data-driven approach focused on outcomes to evaluate their practice on a regular basis
    - **(3)** Technology influences improvements in workflow, and care processes associated nursing informatics transcends the areas defined within exemplary professional nursing practice
        - **i.** Interdisciplinary care, privacy
        - **ii.** Security and confidentiality
        - **iii.** Culture of safety
        - **iv.** Quality of care monitoring and improvement
    - **(4)** There are many specific patient care initiatives (restraint use, falls, pain) that Magnet organizations use to demonstrate their efforts and each organization is required to provide evidence that demonstrates how information systems and technology used to support clinical care is integrated and evaluated
    - **(6)** Magnet organizations are expected to outperform mean or median benchmark performances and to lead the creation of a new delivery system through continuous improvement and research efforts
- **f.** The use of technology to provide access to information through dashboards and business intelligence will assist in the development of new knowledge that will support new care delivery models based on exemplary practice
- **g.** With the new models of care evolving to support the shift toward accountable care technology will be a tool that can help providers to coordinate care across settings with the increasing utilization of health information exchanges
    - **(1)** Organizations will leverage their technology investments to engage patients and families within the community and to connect them with providers in an effort to address care delivery as well as health and wellness
    - **(2)** Exemplary practice will increasingly be about care of the patient where they are—connecting them to care across the continuum

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

New Knowledge, Innovation, and Empirical Quality Outcomes

1. Overview
    - **a.** The demand for exceptional performance and continuous improvement requires Magnet organizations to integrate the current evidence into practice
        - **(1)** Nurses at the bedside drive and champion the adoption of new practices in an effort to provide the best care for their patients
        - **(2)** The impact of technology to support the use of evidence and decision support at the point-of-care is powerful
        - **(3)** The use of data and evidence to drive improvements in care can be found throughout magnet organizations
        - **(4)** It is, in part, due to the nurse's involvement in decisions related to technology and information systems that lead to these improvements in care
        - **(5)** There are many areas where technology can be used to support improvement in care coordination and outcomes such as
            - **i.** Medication reconciliation
            - **ii.** Provider order entry
            - **iii.** Transition of care management
        - **(6)** The magnet framework supports an environment of creating and applying new knowledge to create the future
    - **b.** Organizations must demonstrate activities to support research and innovation and that nurses are involved with the design and implementation of technology to enhance the patient experience and nursing practice
        - **(1)** Nurses play a critical role in system design, selection, implementation, and optimization of information technology and through this work will impact patient safety and quality
        - **(2)** Their involvement will influence the acceptance and adoption of technology to fully allow for the support of informatics, a driver of quality of care, and enhanced patient outcomes
        - **(3)** Informatics will be critical as hospitals and health systems attempt to leverage their electronic medical records to respond to and achieve the "meaningful use" criteria to receive incentives
        - **(4)** Nurses across care settings and roles must be better equipped to understand information technology process to fully optimize to meet the needs of clinicians and patients
        - **(5)** Magnet standards unified with the informatics objective to improve nursing practice through the use of technology provide a compelling transformative nursing agenda
        - **(6)** Magnet organizations are poised to lead this effort as demonstrated by their ongoing commitment to practice excellence
2. Pathway to Excellence
    - **a.** The ANCC Pathway to Excellence program is a program which recognizes a positive nurse practice environment
        - **(1)** Pathway to Excellence evolved from the former Texas Nurses Association's Texas Nurse Friendly Hospital initiative
        - **(2)** Under the ANCC Pathway to Excellence program 12 practice standards considered essential to a positive nurse practice environment provide the foundation
        - **(3)** Like the Magnet program, as part of the process, organizations must demonstrate their ability to address these practice standards

(4) The Pathway program focuses on improving the quality of care delivery and the professional satisfaction of nursing

b. The ANCC's Magnet and Pathway to Excellence programs both highlight nursing excellence in the delivery of quality patient care

(1) The ability to design, deliver, and innovate care organizations and the nursing department must have information technology as an integral component

c. Exemplars where IT initiatives support the Magnet model

(1) In addressing the Magnet model components around new knowledge, innovations, and improvements an organization established the goal of having their nurses provide evidence-based practice more consistently. Collaboration between the Nursing Practice Council, Information Technology and Nursing Leadership fostered the strategy for greater adoption of evidence. After selecting an evidence-based content provider they completed analysis to begin populating their electronic health record with the evidence. Initially this began with the placement of links in the electronic health record where evidence would be most beneficial to the nurse and quickly advanced to specific notes and references to evidence-based practice for specific performance measures. Today, all patient plans of care have been developed using evidence-based content. Changes in practice, process, and IT have led to the successful adoption of evidence-based practice across the organization

(2) In addressing exemplary professional practice an organization developed intra-professional councils to drive IT and changes to IT. Utilizing their council structure including nursing and other disciplines they review aspects of care delivery and how to leverage IT to support those efforts. Nursing Practice Council reviews all documentation practices, including content and defines areas requiring updates and where technology can be used to support practice. The IT Nursing Steering Committee reviews all applications used by nursing across the health system. Nursing practice support by information technology is able to monitor clinical performance so clinicians can see how they are doing and what is happening supporting changes and adjustments in clinical process as needed

Teaching Tip

Refer to http://www.nursecredentialing.org/magnet/programoverview/newmagnet-modelfigure,

Teaching Tip

Review the chapter objectives

- Identify the five components of the ANCC Magnet Model
- Describe how technology has influenced the professional practice environment
- Describe some ways nursing informatics as a specialty can support the achievement of magnet standards and emerging demands of professional practice

Teaching Tip

Ask the students to define the keywords

- Transformational leadership
- Structural empowerment
- Exemplary professional practice

CHAPTER REVIEW QUESTIONS

Question 31.1: What are five components of the ANCC Magnet Model?

a. Structural empowerment, exemplary professional practice, new knowledge innovations and improvement, transformational leadership, and empirical outcomes

b. Structure, process, outcomes, evaluation, and professional standards

c. Professional standards, policies, resources, evidence, and outcomes

d. Structural empowerment, process improvement, research database, evidence, and resources

Question 31.2: Name two ways that technology has influenced the professional practice environment.

a. Improvements in structure and process

b. Improvements in policies and outcomes

c. Improvements in workflow and care processes

d. Improvement in evidence and research

Question 31.3: Nurses in informatics support the Magnet process by ________

a. Understanding structured nursing terminology

b. Nursing informatics transcends the areas defined within exemplary professional nursing practice

c. Nursing informatics can develop functional and structural IT requirements

d. Nursing informatics can utilize metrics to measure outcomes

Question 31.4: Name five areas where nursing informatics promotes exemplary nursing practice

a. Promotes interdisciplinary care, privacy, security and confidentiality, culture of safety, and quality of care monitoring and improvement

b. Promotes national standards, incorporates national policies, facilitates regulatory compliance, reduces costs, and increases outcomes

c. Promotes efficiency, effectiveness, costs reductions, and outcomes

d. Promotes nursing documentation, medication administration, procedure monitoring, symptom management, and cost reductions

Question 31.5: Name three specific patient care initiatives that Magnet organizations use to demonstrate their efforts and each organization is required to provide evidence that demonstrates how information systems and technology used to support clinical care is integrated and evaluated.

a. Pain, restraint use, and falls

b. Pain, medication safety, and falls
c. Pain, pressure ulcer management, and cost impact
d. Pain, cost reductions, and outcomes improvement

Question 31.6: True or False. Magnet organizations are not expected to outperform mean or median benchmark performances and to lead the creation of a new delivery system through continuous improvement and research efforts.

Question 31.7: Name two IT processes that can be employed to provide access to information that will assist in the development of new knowledge that will support new care delivery models based on exemplary practice.

a. Medication carts and smart infusion pumps
b. Patient portals and smart infusion pumps
c. Dashboards and business intelligence
d. Business intelligence and medication carts

Question 31.8: What program did Pathway to Excellence evolve from?

a. From the former Texas Nurses Association's Texas Nurse Friendly Hospital initiative
b. From the coalition of State Nurses Association's Consensus Report
c. From the State of California Nurses Association in conjunction with the California Outcomes Organization
d. From the State of New York Nurses Association's Nurse Friendly Hospital initiative

Question 31.9: What is included in the Magnet research and innovation goals?

a. Nurses are involved with the design and implementation of technology to enhance the patient experience and nursing practice
b. Research and innovation are not goals of the Magnet program
c. While research and innovation are goals, there are no areas specified to attain these goals
d. None of the above

Question 31.10: Name three ways where technology is used to demonstrate care coordination and outcomes in Magnet programs.

a. Medication reconciliation, provider order entry, and transition of care management
b. CPOE, integrated guidelines, and demonstrated cost reductions
c. Medication reconciliation, integrated guidelines, and demonstrated cost reductions
d. None of the above

ANSWERS AND EXPLANATIONS

Question 31.1: (a) Structural empowerment, exemplary professional practice, new knowledge innovations and improvement, transformational leadership, and empirical outcomes.

Question 31.2: (c) Improvements in workflow and care processes.

Question 31.3: (b) Nursing informatics transcends the areas defined within exemplary professional nursing practice.

Question 31.4: (a) Promotes interdisciplinary care, privacy, security and confidentiality, culture of safety, and quality of care monitoring and improvement.

Question 31.5: (a) Pain, restraint use, and falls.

Question 31.6: False. Magnet organizations are expected to outperform mean or median benchmark performances and to lead the creation of a new delivery system through continuous improvement and research efforts.

Question 31.7: (c) Dashboards and business intelligence.

Question 31.8: (a) From the former Texas Nurses Association's Texas Nurse Friendly Hospital initiative.

Question 31.9: (a) Nurses are involved with the design and implementation of technology to enhance the patient experience and nursing practice.

Question 31.10: (a) There are many areas where technology can be used to support improvement in care coordination and outcomes such as medication reconciliation, provider order entry, and transition of care management.

32

Public Health Practice Applications

• OBJECTIVES

1. Define public health informatics and the public health nurse informatician.
2. Describe the National Electronic Disease Surveillance System.
3. Describe two public health electronic information systems with implications for the public health nurse.
4. Discuss the public health informatician role and the emerging role of the public health nurse informatician in case studies.

• KEY WORDS

Public health informatics
Electronic public health surveillance
Electronic public health information systems
Interoperability standards
Office of National Coordinator for Health Information Technology
National Electronic Disease Surveillance System

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: How would you define public health? How would informatics be important to public health? How is informatics important to the public health nurse? Is it important for healthcare organizations such as hospitals to exchange health information with public health departments? Can you give examples of health information that would be exchanged?

For a WIIFM statement, say to the class, "This chapter provides an overview of the application of informatics to public health, describes the legislation that has affected public health information systems, and provides examples of electronic data exchange between clinical care and public health. The chapter also introduces the emerging role of the Public Health Nurse Informatician (PHNI) and gives examples differentiating the public health nurse (PHN) and the PHNI." As a nurse, it is important to understand public health informatics.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites for more information related to the chapter content

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   a. For many years, public health practitioners stated the belief that if nobody thought about public health, then public health must be doing its job
      (1) The battles that health practitioners waged against infectious diseases (such as malaria, tuberculosis [TB], and leprosy), chronic diseases, and environmental health hazards were often not highlighted in the media
      (2) In recent years, after recent outbreaks of SARS and Influenza A virus (H1N1), dramatic large-scale food-borne disease outbreaks, and the explosion of chronic illnesses that are linked to multiple vectors such as obesity, public health is frequently in the media limelight
      (3) The continuing need to be alert to emerging public health problems, responsive in emergencies, and accountable to the public has intensified health

departments' efforts to collect data and information from multiple sources

b. Health departments are collecting and analyzing data on a scale that was inconceivable even 10 years ago

Teaching Tip
Refer to Figure 32.1

(1) To be able to manage this overwhelming deluge of data and information, public health practitioners have tapped into information technology

(2) During 2000–2010, information systems have become widely adapted to fit the special needs within public health

(3) Recognizing the importance of linkages among clinical care (also known as direct care), clinical care information systems, laboratory information systems, and other data sources to better understand and improve the state of the nation's health, public health has helped to establish data and information exchange standards to support system interoperability

Teaching Tip
Review that this chapter provides an overview of the application of informatics to public health, describes the legislation that has affected public health information systems, and provides examples of electronic data exchange between clinical care and public health. The chapter also introduces the emerging role of the PHNI and gives examples differentiating the PHN and the PHNI.

Public Health, Public Health Informatics, Public Health Nursing, and the Public Health Nurse Informatician

1. Overview

a. In 1920, C.-E. A. Winslow defined public health as "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals"

(1) The roots of public health were established in the United States when the Public Health Service (PHS) was established in 1798 by the Marine Hospital Service Act

(2) In 1944, with the passage of the Public Health Service Act [Title 42 US Code], the PHS mission was broadened to protect and advance the nation's physical and mental health

(3) To accomplish this mission, public health had to clearly define the activities that would lead to this desired outcome

b. In a seminal study by the Institute of Medicine, *The Future of Public Health*, the functions of public health were described as assessment, policy development, and assurance

(1) Assessment includes activities of surveillance, case finding, and monitoring trends, and is the basis for the decision making and policy development by public agencies

(2) Policy development is the broad community involvement in formulating plans, setting priorities, mobilizing resources, convening constituents, and developing comprehensive public health policies

(3) Assurance covers activities that verify the implementation of mandates or policies, and guarantees that the provision of necessary resources is provided to reach the public health goals

(4) To further enhance the core public health functions, a committee of public health agencies and organizations convened by the US Public Health Service described the 10 essential services of public health

Teaching Tip
Refer to Figure 32.2 which describes the relationship between the core functions and essential services of public health.

c. The essential governmental role in public health is guided and implemented by a variety of federal, state/territorial, and local regulations and laws as well as federal, state/territorial, and local governmental public health agencies

(1) At the local level, tens of thousands of governmental units at the county, municipality, township, school district, and other special jurisdiction levels must interact to provide public health services

(2) This complex array of public health functions, services, responsibilities, and interactions is not a static environment, but one that is constantly changing

d. Information forms the basis of public health

(1) To make informed decisions and policies, public health practitioners require timely, quality information

(2) The 1996 World Health Report cites the continuing need to "disseminate health information widely, in the sharing of epidemiological and statistical data, reports, guidelines, training modules and periodicals"

(3) Although there are numerous sources of public health data and information, the sources lack standardization in data organization, nomenclature, and electronic transmission

(4) Innovative methods for storing, organizing, exchanging, and disseminating the millions of pieces of data gathered during public health activities have provided the foundation for the field of public health informatics

e. *Public health informatics* has been defined as "the systematic application of information and computer science and technology to public health practice, research, and learning"

(1) Public health informatics, like public health, focuses on populations

(2) In public health informatics, population-level data and information are collected, analyzed, and disseminated with the ultimate goal of supporting preventive, as opposed to curative, interventions

(3) The demarcation between public health and clinical healthcare systems is frequently blurred, especially given legislation that has provided the funding and legal platforms to build the information systems needed to protect and advance the nation's physical and mental health

(4) The provision in the 2004 Health Insurance Portability and Accountability Act (HIPAA) that generally prohibits disclosure of an individual's medical record and payment history without expressed authorization of the individual is known as the Privacy Rule

(5) For public health purposes, the law provides for the disclosure of patient information to public health without authorization from the patient, for the purpose of preventing or controlling disease, injury, or disability, and for the purpose of conducting public health surveillance, public health investigations, and public health interventions

(6) The 2010 Patient Protection and Affordable Care Act (PPACA) provides for the establishment of policies and technically interoperable and secure standards and protocols to facilitate the enrollment of individuals in federal and state health and human services programs

(7) As public health, clinical care, information science, computer science, and information technology continue to come together, the field of public health informatics will continue to expand to support the public health functions of assessment, policy development, and assurance to promote a healthy nation

f. *Public health nursing* is the practice of promoting and protecting the health of populations using knowledge from nursing, and public health sciences

(1) The practice is population focused with the goals of promoting health and preventing disease and disability for all people, through the creation of conditions in which people can be healthy

(2) There are eight principles of public health nursing

i. The population is the unit of care

ii. The primary obligation is to achieve the greatest good for the greatest number of people as a whole

iii. PHNs work with the client as equal partner

iv. Primary prevention is the priority in selecting appropriate activities

v. Focus is on strategies that create healthy environmental, social, and economic conditions in which populations may thrive

vi. The PHN is obligated to actively identify and reach out to all who might benefit from a specific activity/service

vii. The key element of practice is optimal use of available resources to assure best overall improvement in health of the population

viii. PHNs collaborate with a variety of other professions, populations, organizations, and stakeholder groups to promote and protect the health of the people

g. *Public Health Informatician* (PHI) is a "public health professional who works either in practice, research, or academia and whose primary work function is to use informatics to improve population health

(1) The role requires more expertise than the multi-highly functional public health professional that assists with informatics-related challenges or supports personal productivity with information technology"

h. The proposed role of the PHNI combines the competencies of PHI and nursing informatics

(1) The PHNI systematically applies information, computer science and technology, and nursing science to PHN practice, research, and learning

(2) A PHNI is a PHN who has specialized in nursing informatics and has skills in supporting the establishment of systems to improve public health surveillance through access to clinical care information

(3) Further, the PHNI has advanced skills in supporting the use of nursing datasets for more effective clinical care in community surveillance programs

(4) PHNIs ensure that data needs for population groups are adequate for knowledge models related to performance measures

Teaching Tip

These are just some examples of the differences between the PHN and the PHNI that will be described and explained in this chapter.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

2. The public health surveillance landscape

a. The public health mission is to promote the health of the population rather than to treat individuals

(1) In support of this mission, public health workers collect data on the determinants of health and health risks from factors in the pre-exposure environment, the presence of hazardous agents, behaviors, and exposures

(2) Public health workers monitor the occurrence of health events, conditions, deaths, and the activities of the healthcare systems and their effects on health. Public health professionals use these data to inform decisions about the most effective mechanisms for interventions

Teaching Tip

Information from multiple, sometimes incompatible, systems or sources must be combined for an accurate depiction of problems (Figure 32.1).

(3) There is a need for rapid and comprehensive access to data across system boundaries, that is, the system at all levels as well as the healthcare industry systems

b. Data collection and sharing in public health occurs at three levels: local, state/territorial, and federal (e.g., Centers for Disease Control and Prevention [CDC])

(1) Programs at each level have similar organization and management structures

(2) Since most funding is based on programmatic need, many information systems have been built to support specific programs, thereby creating "silo"-like systems

(3) To be productive, the program-oriented funding streams and information systems need to flow together

c. Efforts are underway to assist healthcare providers in overcoming barriers to data collection and sharing through the implementation of regional, state/territorial, and local health information exchanges (HIEs) and the National Electronic Disease Surveillance System (NEDSS) initiative

(1) This comprehensive rather than disease-specific approach to data collection and sharing is the foundation of public health informatics and warrants further inspection

3. Infectious disease electronic surveillance

a. Three levels of the organizational structure of public health have distinct data collection and sharing roles in support of the electronic surveillance system

Teaching Tip
Refer to Figure 32.3 regarding the organizational structure of public health.

(1) Each year, the Council of State and Territorial Epidemiologists (CSTE) and the CDC jointly update a list of reportable diseases and conditions

(2) The CSTE recommends that all states and territories enact laws (statue or rule/regulation as appropriate) to make nationally reportable conditions reportable in their jurisdiction

(3) The local (city or county) health department—the frontline of public health

i. Interacts most closely with clinicians and agencies in the community

ii. Gathers reports of communicable diseases

iii. Tracks and monitors cases

iv. Conducts investigations

v. Often provides direct services (STD testing, vaccines, contact tracing, directly observed therapy, case management)

(4) The state health department uses legislation as well as regulations to require reporting by healthcare entities

i. To report certain illnesses

ii. To require vaccinations for school entry

iii. To coordinate statewide disease surveillance and to monitor incoming reports from counties

iv. Then submit those reports, voluntarily and minus names, to the CDC

(5) The state prioritizes problems and develops programs, runs the state public health laboratory, and serves as liaison between the CDC and local level

(6) The CDC publishes national surveillance summaries and conducts research and program evaluations to produce public health recommendations

(7) The CDC provides grants to states for specific programs, technical assistance, and, by invitation, outbreak response for state and local partners

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

4. National Electronic Telecommunications System for Surveillance (NETSS)

a. In 1984, the CDC, in cooperation with the CSTE and epidemiologists in six states, began testing the Epidemiologic Surveillance Project

(1) The project's goal was to demonstrate the effectiveness of computer transmission of public health surveillance case-based data between state health departments and the CDC

(2) By 1989, all 50 states were participating in the reporting system

(3) The Epidemiologic Surveillance Project was renamed the National Electronic Telecommunications System for Surveillance (NETSS) to reflect its national scope

(4) The NETSS system includes 22 core data elements for reportable disease conditions

(5) The CDC analyzes these data and disseminates them in the *Morbidity and Mortality Weekly Report* (MMWR)

(6) This overwhelming volume of data to be managed by health departments led to the NEDSS initiative, which provides guidance for the technical architecture and standards for nationally reportable condition reporting

(7) When the CDC decided to transition from NETSS to NEDSS, it was determined that no further modification to NETSS would be made

(8) NETSS differs from NEDSS in several ways

(9) NETSS was case based; NEDSS is person based

(10) NETSS used proprietary codes, but NEDSS is based on standards so it can capture data already in electronic healthcare data streams

(11) These differences precipitated the need to transition to NEDSS

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

5. National Electronic Disease Surveillance System (NEDSS)

a. In 1999, the CDC, the CSTE, and state and local public health department staff began work on information system standards for the NEDSS initiative

(1) The NEDSS initiative uses standards to advance the development of efficient, integrated, and interoperable surveillance systems at the state and local levels

(2) This initiative facilitates the electronic transfer of information from clinical information systems in healthcare, reduces the provider's burden of providing data, and enhances the timeliness and quality of information provided

- **b.** Implementation of the NEDSS initiative was supported by the CDC
    - **(1)** States were funded to assess their current systems and develop plans to implement criteria compatible with the NEDSS initiative.
    - **(2)** The criteria included
        - **i.** Browser-based system data entry
        - **ii.** An Electronic Laboratory Results (ELR) system for laboratory staff to report results to health departments as authorized
        - **iii.** A single repository for integrated databases from multiple health information systems
    - **(3)** Also supported were system-wide electronic messaging upgrades for sharing the data
    - **(4)** Finally, the CDC developed a platform called the NEDSS-Base System (NBS) for public health surveillance functions, processes, and data integration in a secure environment
    - **(5)** States then had the option to choose this platform or another NEDSS-compatible system
- **c.** Some states developed systems using specified NEDSS standards, while other states used a CDC-developed system
    - **(1)** To better understand how the NEDSS initiative meets its mission, we will examine the NBS role in supporting public health surveillance

6. Healthcare providers role and the NBS

- **a.** Healthcare providers are responsible for providing clinical care and reporting state-designated reportable conditions to public health departments
    - **(1)** As a registered user of the NBS, a healthcare provider can directly enter data from case and laboratory reports into the state's electronic surveillance system at the point of care
    - **(2)** In addition to the direct entry of data, healthcare providers can securely query the database, verify completeness of reporting using analysis tools, and ensure compliance with state public health laws
    - **(3)** Healthcare providers can send electronic case reports using the Health Level Seven Clinical Document Architecture (HL7 CDA) format when their electronic health record (EHR) is equipped to report in the standard format

7. Clinical laboratories and the NBS

- **a.** Staff members in public and private laboratories are required by law to notify public health departments of state reportable conditions
    - **(1)** Timely reports are critical to public health surveillance because they prompt investigations of cases of reportable diseases or outbreaks
    - **(2)** Registered laboratory users of the NBS system enter reports directly using the Web-based laboratory reporting function of the NBS
    - **(3)** This report is then readily available to the public health NBS users to conduct the investigation

8. Public health practitioner role and the NBS

- **a.** The local or state public health practitioner responds to incoming data on reportable conditions and implements appropriate public health case finding, tracking, and monitoring
    - **(1)** Public health practitioners, who are registered users of the NBS, may review reports from laboratories and healthcare providers for patients residing within their jurisdictional boundaries
    - **(2)** The public health practitioner may create an "alert" function for new data received in the NBS (such as for reports of meningococcal disease)
    - **(3)** Upon receipt of a new report, the public health practitioner may order a public health field investigation
    - **(4)** Clinical, laboratory, epidemiologic, and follow-up data are entered at point of care and stored in the NBS
    - **(5)** Stored data can be read, analyzed, and shared
    - **(6)** The public health practitioner classifies the case, based on stored data and standard case definitions, and forwards the notification to CDC using the NEDSS messaging format, HL7, or NETSS (if no messaging guide exists)
    - **(7)** A data transfer function in the NBS allows users to notify another jurisdiction when a patient moves and to transfer records for follow-up

9. Federal (CDC) role and the NBS

- **a.** A key part of the public health surveillance process is assessment of population health in the United States
    - **(1)** The capabilities of the NBS support public health investigations and interventions at the state level and allow reporting of nationally notifiable diseases in a more complete and standardized manner and in near real time for analysis by CDC program areas
    - **(2)** This supports effective policy formation at the national level when events of public health significance happen
    - **(3)** The data are disseminated through the MMWR

10. Privacy protection and the NBS

- **a.** In order to protect personally identifiable information, the NBS requires user authentication, authorization, and auditing protocols
    - **(1)** To verify the identity of the user, the NBS supports custom authentication
    - **(2)** Once authenticated, the NBS application authorizes access to data based on user role, geographical area(s), disease(s), public health event(s), and action(s)

Teaching Tip

For example, a local public health practitioner may be assigned access to Foodborne and Diarrheal (FDD) investigations and laboratory reports for a public health jurisdiction. The supervisor can be assigned access to multiple public health jurisdictions across multiple families of diseases (e.g., FDD and hepatitis). The NBS creates an audit file containing a fingerprint trail with a timestamp of the user's activities.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

11. Value of information solutions to surveillance practice

  a. NEDSS-compatible infectious disease electronic surveillance systems change how public health departments at all levels communicate to perform their mission

    (1) Access to data repositories is no longer limited to a central location. Rather, epidemiologists, registered as the NBS users, may have data access at all public health levels

    (2) These systems enhance the capacity of local and state public health agencies to react quickly to disease occurrences

12. Future directions for infectious disease surveillance

  a. State public health programs face major funding and infrastructure challenges in adopting the standards-driven information systems for electronic disease surveillance

    (1) The CDC encourages adequate and sustained funding by public health programs for the NEDSS initiative and encourages partners and clinical providers at the point of care to adopt standards and create a uniform, interoperable, and bidirectional process for electronic disease surveillance

    (2) Initiatives such as the CDC's Public Health Informatics Fellowship Program train professionals to apply information science and technology to the practice of public health

  b. Because public health informatics requires the integration of computer science, information science, and information technology into the public health system and with clinical care, one method to better understand how public health information systems work is to examine their application in information

Teaching Tip

The following two cases illustrate public health information systems applied in the context of an Immunization Information System (IIS) and a TB electronic surveillance system.

13. Using informatics in an IIS

  a. Public health has been an advocate for immunization to prevent disease for decades

    (1) Currently, vaccine-preventable diseases are at, or near, record lows

Teaching Tip

Some basic facts provided by the Every Child By Two organization regarding the need for immunization registries indicates that in the United States, there are around 4 million births each year (11,000/day); by age 2, a child will need to have up to 20 vaccinations; 2.1 million children are under-immunized; and 22% of American children see two immunization providers in their first two years

  b. Immunization records and registries began as paper forms that were completed by hand at the point of service

    (1) The immunization record was kept with the patient's file, and an official copy was given to the patient or patient's guardian

    (2) On a periodic basis, usually once a month, all the immunizations records were aggregated by hand (or calculator) with patient demographics and vaccine information written into a registry that was shared with the local health agency

    (3) This time-consuming process contained many vulnerable points where the data could be wrongly entered, incorrectly calculated, or not included in the overall tally

  c. Newer immunization registries are based on electronic IIS

    (1) These IIS are confidential, computerized information systems that allow for the collection of vaccination histories and provide immediate access by authorized users to a child's current immunization status

    (2) One impetus for IIS arose from the *Healthy People 2010* objective (14.26), which stated that 95% of children younger than 6 years of age would be registered in a fully operational IIS

    (3) In 2008, 75% of US children younger than 6 years of age (approximately 18 million children) participated in an IIS, compared to 65% in 2006

  d. Benefits of the implementation of an IIS for the public include having a private and secure place to safeguard important immunization information from multiple providers that will be used throughout a person's life; receiving timely immunization reminders; and eliminating duplicate immunizations

    (1) Benefits for healthcare providers include consolidating immunization records from different sources

      i. Automatically calculating the immunizations needed

      ii. Easily providing official copies of immunization records

      iii. Reducing chart pulls for coverage assessments and Healthcare Effectiveness Data and Information Set (HEDIS) reviews

      iv. Automating vaccine inventory and ordering procedures

      v. Allowing for vaccine tracking during vaccine shortages or manufacturer recalls

      vi. Flagging high-risk patients for timely vaccination recalls

      vii. Assisting with vaccine safety and adverse event reporting

    (2) To accomplish these activities, the IIS must be able to exchange data and information

  e. Data, vocabulary, and transmission standards are critical to IIS success

    (1) A core IIS dataset has been defined, current procedural terminology (CPT) codes have been mapped to CVX (vaccine codes), and MVX (manufacturers of vaccines) codes have been developed to facilitate immunization data exchange between IIS, billing and administrative systems, inventory management systems, and other support systems

    (2) In addition, HL7 standards are used for codes as well as patient demographics, appointment scheduling, file synchronization, and other data management transactions produced and received by the systems

f. The IIS has been successfully implemented in many states

Teaching Tip

Examples include the Michigan Care Improvement Registry (MCIR, 2010), the Oregon Immunization ALERT system, the Wisconsin Immunization Registry (WIR), the Iowa Immunization Registry Information System, and the Louisiana Immunization Network for Kids Statewide (LINKS).

g. Challenges to moving IIS forward include funding and human capacity to build and manage the system
   (1) The HITECH Act (ARRA, 2009) provides funding, and educational programs focusing on informatics will help nurses and others develop skills to refine and effectively use this important public health information system

14. Using informatics in a tuberculosis electronic information system
   a. Tuberculosis is a chronic bacterial infection caused by *Mycobacterium tuberculosis*
      (1) The most common site of infection is the lung, but other organs may be involved
      (2) Healthcare providers are required by laws in all 50 states to report patients with TB and other conditions on the state's list of notifiable conditions
      (3) Confirmed TB cases are reported by clinicians and laboratory staff to local health departments and then to statewide disease surveillance programs connected to state health departments
      (4) A confirmed case of TB is one that meets the clinical case definition or is laboratory confirmed
      (5) Reporting is also recommended for patients who have suspected respiratory TB, to expedite contact tracing and TB transmission control prior to laboratory confirmation
   b. Multiple systems are involved in electronic TB reporting
      (1) Data reporting systems include the National TB Surveillance System, the TB Genotyping Information Management System (TB GIMS), and the Electronic Disease Notification System
   c. The National TB Surveillance System is an electronic incidence surveillance system that collects 49 data items on newly diagnosed verified cases of TB in the United States
      (1) Data are held by the appropriate authority in the state or designated health jurisdiction and transmitted to CDC at three intervals:
         i. Initially at the time of case verification
         ii. At receipt of initial drug susceptibility test results
         iii. At treatment closure
      (2) Formats for reporting TB cases have evolved over decades from
         i. Paper-based reporting beginning in 1952
         ii. To electronic reporting introduced in the mid-1980s
         iii. To an NEDSS-compatible, electronic surveillance system, using HL7 messaging, operational in 2010 for verified TB cases reported in 2009
   d. The TB GIMS builds upon the established infrastructure of the CDC's National TB Surveillance System and incorporates genotype data to create a centralized database and reporting system
      (1) State public health laboratories submit isolates from culture-confirmed cases to one of two designated genotyping laboratories for molecular characterization, which helps with identifying recent transmission and potential outbreaks
   e. The Electronic Disease Notification System alerts state and local health department programs of the arrival of refugees and immigrants to their jurisdictions and provides overseas medical screening results and treatment follow-up information

Teaching Tip

Each refugee or immigrant with a TB classification is referred to the TB program for medical screening and treatment follow-up.

   f. CDC uses data from these reporting systems to disseminate performance measurement reports for national TB-related performance indicators
      (1) CDC shares these reports electronically with health department programs receiving federal funding for TB prevention and control
      (2) The national reports are used by state programs to set performance targets, measure performance, and evaluate the program's capacity to control and prevent TB
   g. Work continues on managing data quality to improve accuracy, completeness, consistency in collecting data, and timeliness of reporting in the National TB Surveillance System
      (1) Additionally, future applications are needed to automate data exchange between the TB reporting systems and to standardize laboratory data for direct reporting to the National TB Surveillance System

15. The PHI and the emerging roles for PHNI
   a. The emerging role of the PHNI is illustrated in case studies to demonstrate the core public health functions of assessment and assurance performed by the PHNI and the PHI

Teaching Tip

In the first case study, the PHI ensured the retrieval of destroyed health records (immunization data) for displaced Hurricane Katrina communities by linking people with their records through informatics. By retrieving health records, the PHI enforced the rules regarding immunization record requirements while ensuring provision of needed immunizations. In the second case study, the PHI, while participating in assessment activities to monitor health status and health problems in displaced Hurricane Katrina communities, identified a norovirus outbreak. The PHI developed and used a simple data checklist of symptoms, and compiled daily information reports and environmental risk information to evaluate the ongoing effectiveness and quality of emergency public health services. In the third case study, the PHNI designed an assessment activity for barriers to adherence behaviors with TB treatment. The PHNI described a clinical nursing information system (CNIS) for a behavioral adherence model adapted to TB program literature. The resulting dataset can be used for data management and performance plan monitoring and to evaluate the effectiveness and quality of personal health services.

Teaching Tip
Have students work in groups of three or four to analyze the case study and report their findings back to the class for further discussion.

Case Study 32.1. Immunization Registries and Emergency Response after Hurricane Katrina

Hurricane Katrina made landfall in Louisiana on August 29, 2005. To escape the storm, more than 200,000 residents of New Orleans and the surrounding area evacuated to shelters in Houston, Texas. In their hurry, they left behind most personal belongings, including immunization records or medical records. Since the hurricane landed as the fall school session was about to begin, state and local school boards in Texas agreed to accept the displaced children into schools without proof of immunization, but stated that proof of immunizations would be necessary to remain in school.

To assist families in finding their children's records, the Houston-Harris County (Texas) Immunization Registry (HHCIR) staff contacted their vendor, who was also the vendor for the Louisiana Immunization Network for Kids Statewide (LINKS), to investigate the possibility of linking the two IIS. In less than 24 hours the HHCIR, vendor, and LINKS personnel had developed a technological bridge built on HL7 standards connecting the two systems. Ten days later they had created a mechanism that allowed health authorities to acquire child and adolescent immunization histories from LINKS. This merged Web-based immunization registry was made available to public health officials and selected healthcare providers in temporary clinics in the Astrodome and George R. Brown Convention Center. Originally the new IIS was a "search and view" only system; the HL7 data exchanges capability was added to allow the LINKS–HHCIR connection to exchange patient data and information from one system to the other.

Over the next month, more than 20,000 records were searched and approximately 10,000 were successfully matched for displaced children in the greater Houston area. By September 2006, 1 year later, nearly 19,000 records had been successfully matched. The estimated cost savings of this on-the-fly, hybrid IIS, just in vaccines for these children, is slightly over $1.6 million. These costs do not factor in the savings in time, pain, and lost work time or missed school that would have occurred if the children had needed to be re-immunized. Nor do the costs reflect the societal costs that may have occurred if the children had not been allowed to attend school. The use of the IIS immunization registry post-Katrina empowered patients, parents, and healthcare providers to know immunization history.

Teaching Tip
Have students work in groups of three or four to analyze the case study and report their findings back to the class for further discussion.

Case Study 32.2. Norovirus Outbreak in Persons Displaced by Hurricane Katrina

Collecting and sharing data and information is essential for public health practice. In September 2005, nearly 1000 evacuees from Hurricane Katrina and relief workers in numerous facilities had symptoms of acute gastroenteritis. A checklist of symptoms was used to collect data on an intake form in medical facilities set up to provide care on an outpatient basis. This information was gathered and entered into a database, and results were distributed each morning.

On September 2, staff observed an increase in adults and children with symptoms of acute gastroenteritis. On some days, nearly 21% of adults and 40% of children visiting one clinic had acute gastroenteritis. They conducted enhanced surveillance to improve identification of acute gastroenteritis, investigated the apparent outbreak, identified the infectious agent, and implemented control measures.

The reported epidemiologic and laboratory findings suggested that an outbreak of norovirus gastroenteritis had affected individuals in numerous facilities. These outbreaks are not associated with contaminated food or water, but spread through person-to-person contact or from fomites in crowded settings. This information was used to provide a health alert for epidemiologic features and clinical presentation, and to promote rehydration treatment and measures to prevent secondary transmission.

Teaching Tip
Have students work in groups of three or four to analyze the case study and report their findings back to the class for further discussion.

Case Study 32.3. Using Informatics for Public Health Program Evaluation

A diagnosis of TB disease or latent TB infection in a child represents recent transmission of *M. tuberculosis*; therefore trends in TB disease and latent TB infection in young children are important indicators to assess the effectiveness of TB prevention and control efforts. Investigations of persons having infectious pulmonary TB can avert TB in children who have been infected with *M. tuberculosis* by finding and treating these children before they progress to TB disease.

Monitoring standardized nursing activities can help identify missed opportunities for prevention. The main types of missed opportunities for preventing TB in young children include not screening the exposed child, perhaps because of incomplete identification of contacts (case interview/investigation adequacy); ensuring that the child starts TB treatment, but not ensuring treatment is completed (caregiver adherence issues); and the infected adult contact who is recommended for treatment either not starting treatment, or starting treatment but not completing it (adherence issues).

A clinical nursing information system (CNIS) dataset, constructed with standardized nursing terminology recognized by the American Nurses Association, is used by PHNs to account for nursing activities, to manage program outcomes, and to describe a planned approach to nursing care. Although the CNIS dataset is used to generate data on patient assessments and to characterize interactions with healthcare providers, it is not targeted to treatment barriers for the patient's adherence needs. In this case, the CNIS dataset would be adapted for the prevention efforts listed above.

Various CNIS datasets can be used. A vendor application of a CNIS is currently used in county and state public health programs in Maine and Minnesota. In Maine, the CNIS is a statewide PHN initiative within the state public health system. It is used to document clinical care and to inform program evaluation. Common tools are nursing care and education plans, flow sheets, and encounter forms for individual client services (TB, MCH, childhood lead poisoning). In Minnesota, the Omaha system contributes to the outcomes management program in local public health departments by providing quantitative data and graphs for program planning, evaluation, and communication with administrators and local government officials.

The standard clinical nursing information has been used to describe a planned approach to perceived barriers to adherence with TB treatment by describing the appropriate support needed to address the challenges of completing long-term TB treatment and perceived barriers to adherence (Table 32.1). Such support is characterized by productive interactions between persons with TB and their healthcare providers who are often TB nurse case managers. The Patient Centered Care (PCC) Model for Perceived Barriers to Adherence with TB Treatment (Table 32.1) helps the nurse identify and document multiple determinants of adherence behavior and useful interventions.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Future Directions in Public Health Information Systems

1. Overview
   a. Although public health information systems have matured over the past decade, many challenges remain
      (1) In general, public health practitioners have not taken an active role in the development of health information systems within their jurisdictions
      (2) Since the bulk of public health activities occur within state/territorial level and local health departments, public health practitioners must provide support and leadership to local healthcare systems in the emerging concept of multiagency responsibility for health
      (3) Local agencies and institutions such as managed care organizations, hospitals, laboratories, environmental health agencies, nursing homes, police staff, community centers, pharmacies, civic groups, corrections staff, drug treatment centers, EMS staff, and home health agencies are partners in maintaining the public's health

Teaching Tip

Figure 32.1 illustrates entities involved in local data/information exchange.

      (4) Additionally, public health practitioners have the expertise needed to inform health information system developers about specific data and information that are needed to make population-based analyses in order to recognize emergent issues in the community, to assist in diagnostic and treatment decisions, and to better understand methods to improve the health of the community
   b. Federal agencies involved in public health can provide the leadership and expertise in developing consensus on data and health information technology standards that will allow for the exchange of public health data and information across public health jurisdictions creating a "network of networks" that function as a national public health information system
   c. Using data in innovative ways through the use of data visualization and decision support systems will increase public health's ability to understand disease trends, make decisions, and apply the appropriate resources where needed
      (1) The use of decision support based on clinical and prevention guidelines can integrate prevention messages into primary care
   d. As some health information technology stabilizes and other technology innovations occur, public health can be the beneficiary of the focus and funding that are driving healthcare reform
      (1) As clinical care and public health continue to integrate and support each other's goal of keeping people healthy, health information technology will provide the platform to improve the health of the nation
2. The future of the PHNI role
   a. The evolving role of the PHNI can contribute to public health practice and the nation's health in several ways:
      (1) The PHNI can support the establishment of systems to improve electronic surveillance through access to clinical care information
      (2) Describe data needs for knowledge models related to performance measures for community surveillance programs (e.g., persons with infectious disease)
      (3) Evaluate the effectiveness, accessibility, and quality of personal and population-based health services in support of electronic surveillance programs

SUMMARY

- In summary, public health, public health informatics, public health information systems, and the ever-increasing integration of public health and healthcare present many opportunities to continually improve the nation's health
- Recent legislation has provided the guidance and funding platforms to create a seamless integration of health information systems to assist with better decision making in patient care and in policy development
- The development of individual data and information system standards is occurring less frequently as nationally recognized health information technology and data exchange standards are stabilizing
- Efforts supporting the certification of the information technology used in health have an impact on the adoption and integration of these standards by information system vendors
- Successful implementations of standards-based information systems have demonstrated enormous cost savings in time and money
- PHNs contribute data to the standards-based data exchange systems; use information to target care for individuals, families, groups, and populations; and then evaluate programs by means of the information systems
- The PHNI seeks partners to understand variables of concern to nurses in clinical care, such as barriers to adherence behaviors, in the development of the standards-based data exchange systems
- The PHNI provides leadership to the PHNs in the use of health information technology to improve the health of the nation

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Define public health informatics and the public health nurse informatician
- Describe the National Electronic Disease Surveillance System
- Describe two public health electronic information systems with implications for the public health nurse
- Discuss the public health informatician role and the emerging role of the public health nurse informatician in case studies

Teaching Tip
Ask the students to define the keywords

- Public health informatics
- Electronic public health surveillance
- Electronic public health information systems
- Interoperability standards
- Office of National Coordinator for Health Information Technology
- National Electronic Disease Surveillance System

CHAPTER REVIEW QUESTIONS

Question 32.1: Public health problems in the United States include monitoring:

a. Malaria, tuberculosis, and leprosy
b. SARS and H1N1
c. HIV, AIDS, and EBOLA
d. All of the above

Question 32.2: Public health informatics includes what types of systems?

a. Clinical information systems
b. Laboratory information systems
c. Statewide surveillance systems
d. All of the above

Question 32.3: True or False. The science of public health has only recently been defined in the 1980s and 1990s.

Question 32.4: The government guiding and implementing regulations and laws for public health resides in what agencies?

a. Only the CDC
b. Only the NIH
c. Many agencies of the government, state and local governments, and some territories

Question 32.5: Public health informatics focuses on what group(s) of people?

a. The patient in a hospital
b. The populations
c. The patient in outpatient departments
d. None of the above

Question 32.6: A Public Health Nurse Informatician (PHNI) is ___________

a. A nurse who combines the competencies of public health informatics and nursing informatics
b. A nurse who is a PHNI systematically applies information, computer science and technology, and nursing science to PHN practice, research, and learning
c. A nurse in PHNI who has advanced skills in supporting the use of nursing datasets for more effective clinical care in community surveillance programs
d. All of the above

Question 32.7: At what three levels does data collection and sharing in public health occur?

a. Local, state/territorial, and federal (e.g., Centers for Disease Control and Prevention [CDC])
b. No data are collected and shared in public health because of HIPAA rules
c. Data are collected at distributed academic centers throughout the United States
d. None of the above

Question 32.8: What efforts are underway to assist healthcare providers in overcoming barriers to data collection, implementation, and data sharing?

a. There are no efforts because of HIPAA rules and the huge expense of sharing national population health
b. Health information exchanges (HIEs) and the National Electronic Disease Surveillance System (NEDSS)
c. The accelerated computer patient record (EHR), and the health information exchanges (HIEs)
d. None of the above

Question 32.9: What are three levels of organizations that recommend the rules/regulations and update the list of reportable diseases and conditions?

a. The CDC, the Council of State and Territorial Epidemiologists (CTSE), and the local city or county health departments
b. ONC, the CDC, and the NIH
c. ONC, the CDC, and the WHO
d. None of the above

Question 32.10: What national standards allow clinicians with an electronic health record report laboratory data and public health reportable diseases from their system?

a. There are no standards developed that currently allow sharing of public health reportable diseases from an EHR

b. HL7 CDA allows the transfer of information to the CDC NBS

c. The SNOMED and LOINC standards allow the transfer of information to the CDC NBS

d. All of the above

ANSWERS AND EXPLANATIONS

Question 32.1: (d) All of the above. The battles that health practitioners waged against infectious diseases (such as malaria, tuberculosis [TB], and leprosy), chronic diseases, and environmental health hazards were often not highlighted in the media. In recent years, after recent outbreaks of EBOLA, SARS, and Influenza A virus (H1N1), dramatic large-scale foodborne disease outbreaks, and the explosion of chronic illnesses that are linked to multiple vectors such as obesity, have all been public health problems monitored in the United States.

Question 32.2: (d) All of the above. Recognizing the importance of linkages among clinical care (also known as direct care), clinical care information systems, laboratory information systems, and other data sources to better understand and improve the state of the nation's health, public health has helped to establish data and information exchange standards to support system interoperability.

Question 32.3: False. In 1920, C.-E. A. Winslow defined public health as "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals."

Question 32.4: (c) The essential governmental role in public health is guided and implemented by a variety of federal, state/territorial, and local regulations and laws as well as federal, state/territorial, and local governmental public health agencies.

Question 32.5: (b) Public health informatics, like public health, focuses on populations.

Question 32.6: (d) All of the above. The proposed role of the Public Health Nurse Informatician (PHNI) combines the competencies of PHI and nursing informatics (American Nurses Association, 2008). The PHNI systematically applies information, computer science and technology, and nursing science to PHN practice, research, and learning. A PHNI is a PHN who has specialized in nursing informatics and has skills in supporting the establishment of systems to improve public health surveillance through access to clinical care information. Further, the PHNI has advanced skills in supporting the use of nursing datasets for more effective clinical care in community surveillance programs.

Question 32.7: (a) Data collection and sharing in public health occurs at three levels: local, state/territorial, and federal (e.g., Centers for Disease Control and Prevention [CDC]).

Question 32.8: (b) Efforts are underway to assist healthcare providers in overcoming barriers to data collection and sharing through the implementation of regional, state/territorial, and local health information exchanges (HIEs) (Wild, Hastings, Gubernick, Ross, & Fehrenbach, 2004) and the National Electronic Disease Surveillance System (NEDSS) initiative.

Question 32.9: (a) Each year, the Council of State and Territorial Epidemiologists (CSTE) and the CDC jointly update a list of reportable diseases and conditions. The CSTE recommends that all states and territories enact laws (statue or rule/regulation as appropriate) to make nationally reportable conditions reportable in their jurisdiction (CSTE, 2010). The local (city or county) health department—the frontline of public health—interacts most closely with clinicians and agencies in the community, gathers reports of communicable diseases, tracks and monitors cases, conducts investigations, and often provides direct services.

Question 32.10: (b) Healthcare providers can send electronic case reports using the Health Level Seven Clinical Document Architecture (HL7 CDA) format when their electronic health record (EHR) is equipped to report in the standard format.

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33

Informatics Solutions for Emergency Planning and Response

• OBJECTIVES

1. Describe the contributions that informatics can provide to emergency planning and response.
2. Illustrate various ways that informatics tools can be designed and used to support decision making and knowledge base building in emergency planning and response efforts.
3. Utilize the 2009 H1N1 example as a case study in how informatics were used to plan and respond to this pandemic event.
4. Project areas of emergency management and response that would benefit from informatics assistance.

• KEY WORDS

Emergencies
Disasters
Public health informatics
Bioterrorism
Biosurveillance

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: have you participated in disaster preparedness activities? Have you ever been involved in an actual disaster? How would informatics be important in a disaster? Have you looked for flu information on the Internet? What Web sites did you visit?

For a WIIFM statement, say to the class, "the purpose of this chapter is to explore the intersection between informatics and emergency planning and response in order to determine current and future informatics contributions. As a nurse, it is important to understand the intersection between informatics and emergency preparedness.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   a. Unfortunately, both natural and manmade disasters have catapulted us into a world that has resulted in making emergency planning and response a high priority need
      (1) There has been a documented rise in terrorism incidents, as well as natural disasters worldwide
      (2) Natural events have ranged from earthquakes, tsunamis, floods, hurricanes, typhoons, to pandemic disease events affecting billions
      (3) Conflicts and nuclear disasters have added to the complexities
      (4) In addition to natural disasters, political and social upheavals massively disrupt the lives and livelihoods of populations and result in the forced displacement of millions of people

  - **(5)** The World Health Organization (WHO) reported that during 2013 they responded to three major crises
    - **i.** Syria, where 9.3 million people were in need of urgent humanitarian assistance
    - **ii.** The Philippines, where Typhoon Haiyan/Yolanda killed nearly 6000 people, devastated the lives of millions, and destroyed over a million homes
    - **iii.** And the Central African Republic, where rising tensions between Muslim and Christian communities and the collapse of the state have left the entire population of the country in fear and affected by the crisis
  - **(6)** These emergencies can have extensive political, economic, social, and public health impacts, with potential long-term consequences sometimes persisting for years after the emergency
  - **(7)** As a result, both planning and response efforts have taken on new importance in relation to emergencies and disasters
  - **(8)** The purpose of this chapter is to explore the intersection between informatics and emergency planning and response in order to determine current and future informatics contributions
- **b.** The United States is not immune from this increased emphasis on emergency preparedness
  - **(1)** The events of September 11, 2001, forced the United States into the realization that the country was not adequately protected from terrorism
  - **(2)** Then, within a short window of time, the anthrax outbreaks stressed the public health infrastructure to the point that bioterrorism arose as an additional deadly threat
  - **(3)** As a result of these two experiences, the government of the United States responded at an unprecedented pace to better prepare and manage terrorist events
  - **(4)** Furthermore, the pandemic H1N1 incident in 2009 created data collection challenges that caused public health officials to creatively provide solutions for meaningful data acquisition in order to be able to effectively manage the event
  - **(5)** Events such as the mass shooting in Newtown, Connecticut, Hurricane Sandy on the eastern coast of the United States, and the horrific tornado in Moore, Oklahoma serve as recent illustrations of how response efforts have had to be altered to meet varied situations
  - **(6)** Hemingway and Ferguson reflected on lessons learned during the Boston Marathon bombing and concluded that emergency preparedness plan updates must reflect the changing types of disasters, changing communication technologies, and the changing workforce
- **c.** Early contributions by the informatics community focused on surveillance of threat detection
  - **(1)** However, as informaticists became more familiar with emergency planning and response, it became clear that contributions toward efficiency, analysis, remote monitoring, telemedicine, and advanced communications would be valued
  - **(2)** The most consistent challenge for emergency and disaster response continues to be communication and information management
  - **(3)** An effective response requires high situational awareness analyzing real-time information to assess needs and available resources that can change suddenly and unexpectedly
  - **(4)** There is a critical interdependence between data collected in the field about a disaster incident, casualties, healthcare needs, triage, and treatment and the needed community resources such as ambulances, emergency departments, hospitals, and intensive care units
  - **(5)** Concurrently, information from the various inpatient facilities and ambulance resources alters the management and disposition of victims at the scene of a disaster
  - **(6)** Opportunities abound for new telecommunication technologies. Smart devices, wireless connectivity, and positioning technologies are all advances that have application during disaster events
  - **(7)** These technologies are being used and evaluated to improve patient care and tracking, foster greater safety for patients and providers, enhance incident management at the scene, coordinate response efforts, and enhance informatics support at both the scene of the disaster and at the community resource levels
- **d.** The 2004 earthquake and tsunami that devastated parts of Southeast Asia illustrated the uncoordinated invasion of people and organizations that resulted in unnecessary duplication, competition, and failure to assist many of the victims in need
  - **(1)** Subsequently, the Interagency Standing Committee (IASC) of the United Nations Office for the Coordination of Humanitarian Affairs (UN-OCHA) initiated changes called the "humanitarian reform"
  - **(2)** This reform effort organized clusters whose principal mission was to assist the impacted government with coordination of all responses and with evaluations of the impact of interventions
  - **(3)** The WHO was appointed as the lead agency for health, which includes coordination and production of health information
  - **(4)** Three of the eight strategic areas of their five-year programme required informatics:
    - **i.** Improve health information and operational intelligence
    - **ii.** Provide baseline information on health risks, health risk reduction and emergency preparedness
    - **iii.** And build emergency preparedness knowledge and skills through training, guidance, research, and information services
  - **(5)** This organization at the global level was aimed at discouraging individual and organizational response efforts that were not part of this coordinated response
  - **(6)** The United States has also organized their planning and response efforts for the same reasons, and informatics is increasingly taking on more important roles in these efforts

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Federal System for Emergency Planning and Response

1. Overview
  a. Most disasters and emergencies are handled by local and state responders
    (1) The federal government provides supplemental assistance when the consequences of a disaster exceed local and state capabilities
  b. Under the Homeland Security Presidential Directive 5 (HSPD5), the Secretary of Homeland Security, as the principal Federal official for domestic incident management, coordinates Federal actions within the United States to prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies
    (1) Coordination occurs if and when any one of the following four conditions applies
      i. A Federal department or agency acting under its own authority has requested the assistance of the Secretary
      ii. The resources of State and local authorities are overwhelmed and Federal assistance has been requested by the appropriate State and local authorities
      iii. More than one Federal department or agency has become substantially involved in responding to the incident
      iv. Or the Secretary has been directed to assume responsibility for managing the domestic incident by the President
    (2) Further, HSPD5 directs Federal department heads to provide their full and prompt cooperation, support, and resources to the Secretary in protecting national security
  c. The National Response Framework, enacted in January 2008, established a comprehensive, national and all-hazards approach to respond to disasters and emergencies
    (1) Built on its predecessor, the National Response Plan, it includes guiding principles that detail how federal, state, local, tribal, and private sector partners, including the healthcare sector, prepare for and provide a unified domestic response, improving coordination and integration
    (2) The Framework emphasizes preparedness activities that include planning, organizing, training, equipping, exercising, and applying lessons learned and assigns lead federal agencies to each of 15 Emergency Support Functions (ESF)
  d. The ESFs group functions are used to provide Federal support during a response and assigns leads for each functional area
    (1) The Department of Health and Human Services leads public health and medical responses, including biosurveillance
  e. The Federal Emergency Management Agency (FEMA) received critical public feedback following their poor response efforts during the 2005 Hurricane Katrina
    (1) Since that time, the agency has creatively added new social media sites, ways to crowdsource disasters, and centralized places to get information

Teaching Tip
Refer to Table 33.1

Teaching Tip
Examples include an interactive emergency kit checklist with information about what to do during specific hazards; a disaster reporter feature where users upload disaster photos with GPS features for posting on a public map; and a new social hub.

    (2) In addition, they have recently added the FEMA LinkedIn page and the US Fire Administration Facebook page where there are job listings, stories about what a “day in the life” looks like at FEMA, other training resources, and tips for assisting fire departments or firefighters

Teaching Tip
Have the students work in groups and discuss the case study. Have the students report their findings back to the class.

Case Study 33.1. Informatics and 2009 H1N1

Although there have been other viruses that have surfaced with the potential to become pandemic, the 2009 H1N1 influenza pandemic continues to be the most recent pandemic and illustrates how informatics can contribute to an emergency response. Initially concerned that a circulating H5N1 virus (Avian Influenza A) was mutating and could cause a human pandemic, global experts had focused efforts over the last several years on rapidly developing catastrophic plans even though a pandemic virus had not emerged. There were significant concerns, given that during the 20th century three flu pandemics were responsible for more than 50 million deaths worldwide and almost a million deaths in the United States (Department of Health and Human Services) (Table 33.2). The CDC estimates that 43 to 89 million people had H1N1 between April 2009 and April 2010, and they estimate between 8870 and 18,300 H1N1 related deaths. On August 10, 2010 the WHO declared an end to the global H1N1 flu pandemic.

Many governments believed that if a pandemic-capable virus emerged, there would be rapid worldwide spread as the 1918 Pandemic had spread across countries and continents in less than one year in a time without commercial air travel to facilitate the spread of disease. It was understood that a worldwide influenza pandemic occurring in this century could have major effects on the global economy, especially travel, trade, tourism, food, consumption and, eventually, investment and financial markets and could lead to widespread economic and social disruptions. As a result, many countries engaged in detailed pandemic planning and prepared to adopt draconian-like measures to delay but not stop the arrival of the virus, such as border closures and travel restrictions.

Here in the United States, modelers predicted catastrophic death estimates (Table 33.3). The 1918–1919 flu pandemic, to date the most severe, had caused the deaths of at least 675,000 Americans and affected about one-fifth of the world’s population. Researchers believed that if a pandemic of similar severity occurred today, 90 million Americans could become ill, quickly exceeding available healthcare capacity and result in approximately 2 million Americans deaths.

Preparedness planners assumed that all populations were at risk. They believed that disease would be widespread, affecting multiple areas of the United States and other countries at the same time preventing the redistribution of resources. The world would experience multiple waves of outbreaks potentially occurring for an extended period of time (over 18 months), affecting the entire United States for a period of 12 to 16 weeks with community waves each lasting 6 to 8 weeks. One to three pandemic waves would occur. Further, planners believed that a pandemic could affect as many as 40 percent of the workforce during periods of peak flu illness, predicting that employees could be absent because of their own illness, or would be caring for sick family members or for children if schools or daycare centers are closed. They also recognized that workers would be absent if public transportation was disrupted or if they were afraid to leave home.

Adopting a "worst case scenario," government experts rapidly developed a number of strategies to help local governments plan, stating that the Federal government would not likely be able to provide any assistance during the actual pandemic. For example, DHHS developed a Pandemic Severity Index (PSI) to characterize the severity of a pandemic. It was designed to predict the impact of a pandemic and provide local decision makers with standardized triggers that were matched to the severity of illness impacting a specific community (Table 33.4). The severity index was based on a case-fatality ratio to measure the proportion of deaths among clinically ill persons. Recommended actions were identified in advance, and communicated to the public in hopes of increasing their understanding and compliance. Using the PSI, a severe pandemic influenza, similar to the 1918 Pandemic, was defined as a category 4 or 5, with 20 to 40 percent of the population infected. For a severe pandemic, HHS recommended that localities be prepared to dismiss children from schools and close daycares for up to 12 weeks; as well as initiate adult social distancing, which included suspension of large public gatherings and modification of the workplace schedules and practices (e.g., telework and staggered shifts).

The Centers for Disease Control and Prevention, part of HHS, monitors influenza activity and trends and virus characteristics through a nationwide surveillance system as well as estimates the burden of flu illness using statistical modeling. On April, 29, 2009, the CDC began reporting cases of respiratory infection with swine-origin influenza A (H1N1) viruses transmitted through human-to-human contact. It established the case definition for 2009 H1N1 as an acute febrile respiratory illness in a person and laboratory-confirmed swine-origin influenza A (H1N1) virus infection at CDC by either of the following tests: real-time reverse transcription-polymerase chain reaction (rRT-PCR), or viral culture. The CDC began tracking and reporting the number of cases, hospitalizations and deaths at state, local, and national levels using standard state reporting mechanisms. It was soon apparent that using actual case counts resulted in dramatically underreported disease.

On July 24, 2009, CDC abandoned initial case counts, when it recognized that those numbers represented a significant undercount of the actual number of 2009 H1N1 cases. They found that 2009 H1N1 was less severe and caused fewer deaths than expected when compared to the pandemic planning assumptions. As a result, existing plans, which used case fatality numbers as the trigger for initiating response actions, were not effective.

Scientists turned to other means to begin to understand the effects of disease and predict its future course. For example, because trending indicated that children and young adults were at higher risk, the Department of Education began looking at school closures and school absenteeism, examining both teacher and student absences. Each of the critical infrastructure key resource sectors held weekly calls with private sector partners to elicit whether there were trends beginning to indicate business interruption problems, which might forecast social disruptions. The National Retail Data monitoring system tracked the real-time purchase of over-the-counter (OTC) medications, such as fever reducers and influenza treatments, in over 29,000 retail pharmacies, groceries, and mass merchandise stores. This University of Pittsburgh system is used to provide early detection of naturally occurring disease outbreaks as well as bioterrorism.

The CDC moved to using estimates. Using the influenza module from BioSense, CDC tracked flu with data from over 500 local and state health departments, hospital emergency rooms, Laboratory Response Network labs, Health Information Exchanges as well as the Departments of Defense and Veterans Affairs. The Real-time Outbreak Disease Surveillance (RODS) took chief complaint information from clinical encounters hospitals and classified it into one of seven syndrome categories using Bayesian classifiers. The data is stored in a relational database, used univariate and multivariate statistical detection and alerted users of when the algorithms identify anomalous patterns in the syndrome count. Interpreting these estimates, one study hypothesized that for every reported lab-confirmed case of H1N1 between April and July 2009, there were an estimated 79 total cases. The same study found that for every identified hospitalized case there were more likely 2.7 hospitalized people.

Concerned that the limited capacity of the healthcare system would be overwhelmed and finite resources such as H1N1 test kits would be consumed, CDC published updated self-treatment guidance and told the public that H1N1 testing was no longer necessary. Instead, persons with minor flu-like illnesses were assumed to be infected and encouraged to utilize advice lines staffed by nurses to obtain answers to questions rather than to seek appointments with healthcare providers. For the first time the US government established a one-stop federal Web site (www.flu.gov) that housed information such as frequently asked questions as well as messaging aimed at individuals and families, businesses, and healthcare professionals from across the federal interagency. The Web site contained tailored planning documents for schools and communities, and included targeted information for special populations. One particularly helpful site was a Flu Vaccine Locator, which contained a database that provided the general public with the locations of clinics that had vaccine supplies utilizing zip codes.

For the first time, HHS used social media to communicate with young people. Recognizing that large numbers of young adults were affected, they launched a Facebook application "I'm a Flu Fighter!" that allowed and encouraged users to spread information about H1N1, such as where they received the H1N1 vaccine, to their Facebook friends.

Other recent viruses have arisen, but cannot be categorized as pandemic because they have not caused sustained and efficient human-to-human transmission. Informatics has been important in this reporting and analysis. H5N1, commonly known as avian influenza ("bird flu") is such an example. In July 2013, WHO announced a total of 630 confirmed human cases which resulted in the deaths of 375 people since 2003, but did not meet pandemic criteria. Also in 2013, the American Academy of Family Physicians reported that the case numbers of H7N9 stalled in China, but that the pandemic potential remains. H7N9 is an unusually dangerous virus for humans with cases resulting in severe respiratory illness, with a mortality rate of roughly 30 percent. H7N9 does not kill poultry, which makes surveillance much more difficult. Other recent threats include a new respiratory virus Middle East Respiratory Syndrome (MERS-CoV), which arose in 2013 in Saudi Arabia. Todd concludes that since all viral mutations are unpredictable, it is impossible to predict whether any of these viruses or yet another emerging virus will be the cause of a new pandemic. We must, therefore, continue our diligence in surveillance activities.

2. Healthcare consumers contribute to surveillance activities
    - **a.** In the H1N1 case study described above, healthcare consumer data became an important aspect of the disease surveillance model that augmented data collected by the CDC
        - **(1)** Why was that the case?
        - **(2)** Now more than ever before, consumers have the opportunity to contribute to surveillance activities
        - **(3)** In some cases, the participation is a conscious decision, but in others consumers may be unknowingly contributing to this informatics process
    - **b.** Part of the advantage of externally generated CDC surveillance mechanisms is that they shorten the typical lag time to publication for CDC's publicly reported data which is currently estimated to be from 10 to 14 days
        - **(1)** Telephone triage data is now being used to help track influenza in a specified geographic location with the added advantage that the data is real-time in nature
        - **(2)** In addition, patient demographics and disease symptoms can also be captured in a standard format
        - **(3)** Another new mechanism for data capture about influenza is through physician group proprietary systems
        - **(4)** In these systems, the healthcare providers enter the data for suspected or confirmed influenza patients
        - **(5)** By far, the most talked about trend in influenza surveillance for the 2009 H1N1 outbreak was Google's Flu Trends
        - **(6)** The assumption made with this system was that there was a relationship between how many people search the Internet for flu-related topics and how many people have flu-like symptoms
        - **(7)** In studies conducted by Google.org comparing Google Flu Trends to CDC published data, they found that the search-based flu estimates had a consistently strong correlation with real CDC surveillance data

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Competency-Based Learning and Informatics Needs

1. Overview
    - **a.** In order to provide a successful nursing response effort, nurses must be appropriately and consistently educated to provide the right response
        - **(1)** Competency-based education provides an international infrastructure for nurses to learn about emergency preparedness and response
        - **(2)** Yet, currently there are no accepted, standardized requirements for disaster nursing training or continuing education
    - **b.** There have been, however, a number of competency development efforts geared to different nursing audiences
        - **(1)** In collaboration with the CDC, researchers from the Columbia University School of Nursing identified nine objectively measurable skills for public health workers and seven competencies for leaders, followed by an additional three competencies for public health professionals
        - **(2)** There were also two competencies identified for public health technical and support staff relating to
            - **i.** Demonstration of equipment and skills associated with his/her functional role in emergency preparedness during regular drills
            - **ii.** And description of at least one resource for backup support in key areas of responsibility
        - **(3)** In 2003, the International Nursing Coalition for Mass Casualty Education (later renamed the Nursing Emergency Preparedness Coalition, or NEPEC) generated a list of 104 competency statements for all nurses responding to disasters using domains developed by the American Association of Colleges of Nursing
        - **(4)** Additional competencies were developed by the University of Hyogo and the International Council of Nurses.
        - **(5)** All of the competency efforts were considered by a WHO group of nursing experts as they developed competency domains during the first consultation on nursing and midwifery in emergencies
    - **c.** Efforts to identify content to match competencies have also proven successful
        - **(1)** An additional group of experts met following WHO's first consultation on nursing and midwifery contributions in emergencies to identify possible content that matched the identified competencies at the undergraduate nursing level
        - **(2)** Online modules produced by NEPEC and the National Nursing Emergency Preparedness Initiative (NNEPI) both received international awards from Sigma Theta Tau International for quality computer-based education programs
    - **d.** The CDC currently sponsors a public health informatics fellowship program that is a two year paid fellowship in public health informatics
        - **(1)** The competency-based and hands-on training allows students to apply information and computer science and technology to solving real public health problems
2. Informatics and incident management
    - **a.** Information technology staff members have long been familiar with emergency planning for disaster recovery related to their systems, but find themselves in a new role as part of a more comprehensive team approach to disasters and emergencies
        - **(1)** The incident management system (IMS) was first used by firefighters to control disaster scenes in a multijurisdictional and interdepartmental manner
        - **(2)** The IMS calls for a hierarchical chain of command led by the incident manager or commander

- **(3)** Each job assignment is consistently followed by assigned personnel who refer to a specific job action sheet
- **(4)** This system improves communication through a common language, allows staff to move between management locations, and facilitates all responders to understand the established chain of command
- **(5)** The IMS has been adapted for hospital use and is called the Hospital Incident Command System (HICS)

b. The Emergency Operations Center (EOC) is the physical location where the Incident Management Team convenes to make decisions, communicate, and coordinate the various activities in response to an incident

- **(1)** Accurate, real-time data acquisition regarding patient needs, rescue personnel, and resources available is critical to overall coordination
- **(2)** Table 33.5 presents functions where technology can be used to capture and represent data for purposes of increasing situational awareness in the EOC for the purposes of making the most informed and efficient decisions
- **(3)** In addition, the informatics processing efforts that contribute to the IMS are also described

3. Informatics and volunteerism

a. Healthcare volunteers are a necessary component of mass casualty events, but also create challenges

- **(1)** How do you count volunteers so that they are only entered once?
- **(2)** How do you educate them so that they can perform effectively when needed?
- **(3)** How are liability issues dealt with?
- **(4)** Are there certain tasks that lend themselves to volunteer efforts?
- **(5)** Some states offer their nurses the opportunity to volunteer when they renew their nursing licensure
- **(6)** It is then possible for statewide volunteer databases to be built, but these are only shared within the state system
- **(7)** Some states require a set number of hours of continuing education in emergency preparedness in order to renew licensure

b. The federal government does have a system for organizing teams that are willing to travel to other regions of the country in the event of an emergency

- **(1)** These teams are called disaster medical assistance teams (DMATs)
- **(2)** When DMATs are activated, members of the teams are federalized or made temporary workers of the federal government, which then assumes the liability for their services
- **(3)** Their licensure and certifications are then recognized by all states

c. The Medical Reserve Corps (MRC) and the Emergency System for Advance Registration of Volunteer Health Professionals (ESAR-VHP) both represent initiatives of the DHHS to improve the nation's ability to prepare for and respond to public health emergencies

- **(1)** The MRC was founded after President Bush's 2002 State of the Union address, in which he asked all Americans to volunteer in support of their country
- **(2)** The MRC is a national network of community-based volunteer units that focus on improving the health, safety, and resiliency of their local communities
- **(3)** MRC volunteers include medical and public health professionals such as
  - **i.** Physicians
  - **ii.** Nurses
  - **iii.** Pharmacists
  - **iv.** Dentists
  - **v.** Veterinarians
  - **vi.** And epidemiologists
- **(4)** Many community members—interpreters, chaplains, office workers, legal advisors, and others—can fill key support positions

Teaching Tip
Provide the example, nurses trained in informatics are often used by MRC units to compile needed databases depending on the response effort at hand. At the time of this writing, there are 991 units composed of 206,770 volunteers, covering 73.69 percent of the United States.

d. The national ESAR-VHP program provides guidance and assistance for the development of standardized state-based programs for registering and verifying the credentials of volunteer health professionals in advance of an emergency or disaster

- **(1)** Each state program collects and verifies information on the identity, licensure status, privileges, and credentials of volunteers
- **(2)** These programs are built to a common set of national standards and give each state the ability to quickly identify and assist in the coordination of volunteer health professionals in an emergency
- **(3)** These registration systems include information about volunteers involved in organized efforts at the local level (such as MRC units) and the state level (DMAT and state medical response teams)
- **(4)** In addition, individuals who prefer not to be part of an organized unit structure can also be entered into the registry in order to allow for a ready pool of volunteers
- **(5)** State ESAR-VHP programs provide a single, centralized source of information to facilitate the intrastate, interstate, and state-to-federal deployment or transfer of volunteer health professionals
- **(6)** Several collaboration suggestions have been generated in an effort to integrate both the MRC and ESAR-VHP initiatives, including having state coordinators for both initiatives

e. Most volunteer opportunities require education prior to responding to the event. MRC units have competency-based education requirements

- **(1)** The American Red Cross has a long history of volunteerism during disasters, and has education requirements for nurses depending on what roles they will play in disaster relief

- **(2)** Regardless of the group, nurses are urged to be a part of an organized group rather than simply showing up on the scene of a disaster and contributing to the confusion
- **(3)** All of these initiatives require informatics solutions in order to function effectively
- **(4)** Organizing the results of these efforts into a standardized registry allows for more informed decisions and increased efficiency of services during times of response and relief efforts

4. Disaster electronic medical records and tracking

- **a.** Expanding the use of the electronic health record should help both patients and their healthcare providers during times of emergencies and disasters
  - **(1)** Accessing clinical data for displaced patients should also improve tremendously with interoperable data and the sharing of clinical information, all recent initiatives from the Office of the National Coordinator (ONC) for Health Information Technology
  - **(2)** One project that emerged from that office during Hurricane Katrina was called KatrinaHealth and illustrated such potential with the pooling of information resources across federal and private sectors
  - **(3)** KatrinaHealth.org was a free and secure online service that provided Katrina evacuees, their authorized healthcare providers and pharmacists with a list of the prescription medications evacuees were taking before they were forced to leave their homes, lost their medications, and the medical records
- **b.** Another situation served to illustrate the importance of the electronic health record when an EF5 tornado struck Joplin, Missouri, on May 22, 2011
  - **(1)** Significant damage was inflicted on St. John's Regional Medical Center, claiming the lives of 5 of its 188 patients and 1 visitor
  - **(2)** The EHR system had been implemented only three weeks earlier, and fortunately had a regional backup in Springfield, Missouri
  - **(3)** Besides being able to access patient records, the informatics staff were able to modify the names and beds in the units to reflect the temporary facilities that were needed due to damage in the main facility
  - **(4)** A number of regional physician practices were also able to resume caring for patients in alternate sites
- **c.** DeMers et al. (2013) describe a secure, scalable disaster electronic medical record and tracking system called the Wireless Internet Information System for medical Response in Disasters (WIISARD)
  - **(1)** This system is a handheld, linked, wireless EMR system utilizing current technology platforms
  - **(2)** Smartphones connected to radio frequency identification readers can be used to efficiently track casualties resulting from the incident
  - **(3)** Medical information can be transmitted on an encrypted network to fellow team members, medical dispatch, and receiving medical centers
  - **(4)** The authors report that the system has been field tested in a number of exercises with excellent results
  - **(5)** This pre-hospital EMR merges data with the receiving hospital EMR using HIPAA-compliant methods
  - **(6)** Fayaz-Bakhsh and Sharifi-Sedeh are critical in noting that one of the most typical consequences of disasters is the near or complete collapse of terrestrial telecommunications infrastructures, resulting in disaster managers having difficulty getting Internet connectivity or cell phone coverage
  - **(7)** The WIISARD team recognized those concerns and used an ad hoc field network that could circumvent challenges around damaged or overwhelmed traditional communication network systems
- **d.** Tracking of patient victims is another important function needed during disaster and emergency events
  - **(1)** The allocation of various resources over multiple geographical locations makes for a complex decision-making process, thus allocation of patients to hospitals and adequate patient tracking and tracing are major issues
  - **(2)** Accurate and current information is critical for situational awareness—the ability to make timely and effective decisions during rapidly evolving events
  - **(3)** In order to overcome such challenges, these authors developed a Victim Tracking and Tracing System (ViTTS)
  - **(4)** Their system design allowed for early, unique registration of victims close to the impact site that was able to later connect to the receiving systems
- **e.** Mobile health (mHealth) technology can also play a critical role in improving disaster victim tracking, triage, patient care, facility management, and theatre-wide decision making
  - **(1)** Callaway et al. (2012) thought that the delivery of care after disasters like the earthquake in Haiti could be better integrated using mHealth
  - **(2)** They chose to develop, deploy, and evaluate a novel electronic patient medical record and tracking system in the immediate post-event setting
  - **(3)** An iPhone-based mobile technology platform called iChart was selected
  - **(4)** During their implementation, there were 617 unique patient entries into the patient tracker, resulting in an adequate ability to triage patients as they arrived as new transfers
  - **(5)** Users rated that the iChart improved provider handoffs and continuity of care, and standardized the information into one language
  - **(6)** Given the chaotic nature of volunteer physicians' arrivals and departures, the mobile application also accommodated fluctuating provider schedules by keeping a centralized repository of basic patient information
  - **(7)** The online database was also used to generate daily census figures
- **f.** Case, Morrison, and Vuylsteke (2012) reviewed the literature to determine ways that mobile technology could help disaster medicine
- **g.** They classified applications into five types
  - **i.** Disaster scene management
  - **ii.** Remote monitoring of casualties
  - **iii.** Medical image transmission
  - **iv.** Decision support applications
  - **v.** And field hospital information technology systems

5. Future advances
   a. While the 2009 pandemic fortunately was far less severe than the "Armageddon-like" event that planners forecasted, it served to highlight many opportunities for the use of informatics to assist in emergency preparedness and response
      (1) Health information technology investments are a necessary foundation in healthcare reform, linking potentially valuable information such as vaccination records and subsequent use of healthcare services to provide information about adverse events as well as vaccine effectiveness
      (2) Already, the CDC works closely with WHO to make certain that many of the databases link to one another, but over time this will improve as well
      (3) Continuing to pay attention to social media for crowdsourcing, for trending, and for analysis of text messages will remain an important contribution to disaster care
   b. Using "grids" to connect multiple computers across the country will allow data sources to share and view large amounts of health information
      (1) Grid participants will be able to analyze data in other jurisdictions without moving the actual data, which is an important step forward in overcoming policy barriers to moving data out of a jurisdiction to protect individual privacy
   c. Having interoperable patient data is a current goal of the ONC for Health Information Technology, but it will also serve to improve the data available as victims become dispersed from their typical healthcare environments
      (1) Pulling that data closer to the point of care with mobile devices will only enhance the quality of data available for healthcare providers to make critical decisions with limited time and resources
      (2) Allowing this data to be transmitted across international lines will most certainly assist in our quest to provide healthcare to victims regardless of where they seek shelter
      (3) International communication standards will also become an important factor in improving communication across borders

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- In conclusion, the 2009 H1N1 outbreak was a recent example of emergency preparedness and response
- It reinforced the fact that estimating the number of actual flu cases is very challenging as current case counting relies on encounter information, which is prone to underreporting
- Informatics is an emerging field that has the potential to immediately support the early identification of a communicable disease such as pandemic influenza, reducing loss of life, and the consumption of limited resources
- Use of automated case specific disease monitoring applications such as BioSense, ESSENCE, and RODS and tracking retail data such as OTC medication purchases allows researchers to collect, analyze, and present real-time disease information which allows users to have immediate access to information that previously would have taken days to assemble
- Technological developments will further enhance the ability to use informatics to detect the first warning signs during an emergency
- Consumers themselves have assumed surveillance roles in their quest to seek data and information resources
- The increase use of social media provides a new mechanism for data collection and trending
- Coordinated response efforts require excellent communication based on efficient decision making
- Informatics can contribute to this agenda, particularly in an era when healthcare resources are dwindling. Informatics infrastructure contributes continuous monitoring of data, standards for combining data, technology-enhanced processing and analysis that help to detect significant patterns, centralized diagnostic tool and protocols for treatment, and advanced communication technology
- As a result, informatics solutions need to remain central to emergency planning and response efforts

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe the contributions that informatics can provide to emergency planning and response
- Illustrate various ways that informatics tools can be designed and used to support decision making and knowledge base building in emergency planning and response efforts
- Utilize the 2009 H1N1 example as a case study in how informatics were used to plan and respond to this pandemic event
- Project areas of emergency management and response that would benefit from informatics assistance

Teaching Tip
Ask the students to define the keywords

- Emergencies
- Disasters
- Public health informatics
- Bioterrorism
- Biosurveillance

CHAPTER REVIEW QUESTIONS

Question 33.1: Name two areas of disasters.

- **a.** Natural and manmade
- **b.** Natural and hurricanes
- **c.** Natural and tsunamis
- **d.** Manmade and terrorism

Question 33.2: Name three environments from disasters that the WHO reported in 2014.

- **a.** Syria, Central Africa, and the Philippines
- **b.** The United States, Syria, and Lebanon
- **c.** Syria, the Philippines, and Saudi Arabia
- **d.** None of the above were WHO disasters reported environments in 2014

Question 33.3: True or False. Emergencies can have extensive political, economic, social and public health impacts, with potential long-term consequences sometimes persisting for years after the emergency.

Question 33.4: What event occurred that informed the United States that it was not immune from manmade disasters?

- **a.** Hurricane Hugo
- **b.** Mississippi Floods
- **c.** The events of September 11, 2001
- **d.** None of the above

Question 33.5: What pandemic occurred that informed the United States that it should focus on the need to creatively provide solutions for meaningful data acquisition in order to be able to effectively manage infections and pandemics?

- **a.** The Hurricane health effects in Puerto Rico
- **b.** The H1N1 in 2009
- **c.** The flood Cholera in the Mississippi
- **d.** There have been no pandemics facing the United States

Question 33.6: True or False. The Boston Marathon bombing concluded that emergency preparedness plan updates must reflect the changing types of disasters, changing communication technologies, and the changing workforce.

Question 33.7: Name two areas that informatics can provide to emergency planning and response such as flu.

- **a.** Monitoring emergency room patient admission diagnosis, and tracking retail data for an expanded use of over the counter medications
- **b.** Monitoring the changes in weather and available beds at local hospitals
- **c.** Monitoring traffic and changes in weather in affected areas
- **d.** None of the above

Question 33.8: The most consistent challenge for emergency and disaster response is __________

- **a.** Communication and information management
- **b.** Staffing and scheduling the workforce
- **c.** Patient triage and information management
- **d.** Certifying credentials of the workforce, and communication management

Question 33.9: High situational awareness includes __________

- **a.** Analyzing real-time information to assess needs and available resources that can change suddenly and unexpectedly
- **b.** Data collected in the field about a disaster incident, casualties, healthcare needs, and triage
- **c.** Data about available treatment and the needed community resources such as ambulances, emergency departments, hospitals, and intensive care units
- **d.** All of the above

Question 33.10: Name three new telecommunication technologies that are being applied to emergency management and disaster events

- **a.** Smart devices, wireless connectivity, and positioning technologies are all advances that have application during disaster events
- **b.** Smart devices, surveillance cameras and the patient personal health record
- **c.** The patient personal health record, immunization history, and medication profiles
- **d.** None of the above

ANSWERS AND EXPLANATIONS

Question 33.1: (a) Natural and manmade.

Question 33.2: (a) Syria, Central Africa, and the Philippines.

Question 33.3: True. Emergencies can have extensive political, economic, social, and public health impacts, with potential long-term consequences sometimes persisting for years after the emergency.

Question 33.4: (c) The events of September 11, 2001.

Question 33.5: (b) The H1N1 pandemic in 2009.

Question 33.6: True. The Boston Marathon bombing concluded that emergency preparedness plan updates must reflect the changing types of disasters, changing communication technologies, and the changing workforce.

Question 33.7: (a) Monitoring emergency room patient admission diagnosis, and tracking retail data for an expanded use of over-the-counter medications.

Question 33.8: (a) Communication and information management are the most consistent challenges for emergency and disaster response.

Question 33.9: (d) All of the above. Situational awareness requires a critical interdependence between data collected in many environments, including a, b, and c.

Question 33.10: (a) Smart devices, wireless connectivity, and positioning technologies are all advances that have application during disaster events.

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Federal Healthcare Sector Nursing Informatics

• OBJECTIVES

1. Describe the history of nursing informatics in the federal healthcare sector.
2. Briefly describe the various roles of nursing informaticists in the federal sector.
3. Articulate how technology supports information sharing and collaboration with emphasis on the unique populations within the federal sector.
4. Discuss the high risk and high impact informatics challenges facing the federal government.

• KEY WORDS

Federal healthcare sector
Nursing informatics roles and responsibilities
Informatics technology and challenges in federal government
Federal nursing informatics
Military nursing informatics
Veteran Affairs nursing informatics

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you provide examples of the federal healthcare system? What government agencies and branches of the military are involved in the federal healthcare? What is the role of the federal healthcare systems in informatics and nursing examples? How would the federal healthcare systems use informatics?

For a WIIFM statement, say to the class, "the federal healthcare system supports the growth and advancement of professional nursing roles, standards and technologies. The federal nursing sector supports healthcare informatics in diverse practice settings and agencies, but the focus of this chapter is limited to the Department of Defense (DoD) Military Health Services (MHS) of the Air Force, Army, Navy; the Department of Veterans Affairs (DVA); and the United States Public Health Services (USPHS)." As a nurse, it is important to understand and appreciate the contributions of the federal healthcare sector to nursing informatics.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

The Emergence of Nursing Informatics within the Federal Healthcare Sector

1. Introduction
    a. The US federal healthcare system is one of the largest integrated health delivery entities in the world and is a dynamic "systems of systems" architectural model
        (1) The system has a long history of innovation, adoption, research, development, implementation and evaluation in technological advances

- **(2)** Over six decades, federal nursing informaticists have been at the forefront of various professional development initiatives and computer applications (American Medical Informatics Association [AMIA])
- **(3)** The federal healthcare system supports the growth and advancement of professional nursing roles, standards, and technologies
- **(4)** The federal nursing sector supports healthcare informatics in diverse practice settings and agencies, but the focus of this chapter is limited to
    - **i.** The Department of Defense (DoD) Military Health Services (MHS) of the Air Force, Army, Navy
    - **ii.** The Department of Veterans Affairs (DVA)
    - **iii.** The United States Public Health Services (USPHS)

2. Federal sector ecosystem

- **a.** The federal healthcare sector often is referred to as the "public" or "government" segment
    - **(1)** The discipline of nursing informatics within the federal sector is the origin of numerous innovations and milestones cutting across diverse public healthcare agencies
    - **(2)** Collaboration and shared communication among all healthcare professionals are vital to providing the delivery of quality, effective care across the spectrum of nursing care while ensuring the use of nursing processes in the area of informatics
    - **(3)** A brief description of the three federal healthcare entities is described next

3. Department of Defense (DoD) healthcare landscape

- **a.** The DoD Military Health System (MHS) provides global healthcare services to over 9.6 million beneficiaries to include active duty service members, National Guard and Reserve members, retirees, and their families
    - **(1)** The MHS is composed of over 130,000 Air Force, Army, and Navy healthcare professionals
    - **(2)** The MHS manages individual health benefits and costs through the TRICARE program, similar to private insurance companies such as Blue Cross/Blue Shield
    - **(3)** TRICARE brings together the uniformed services resources and supplements them with networks of civilian healthcare professionals, institutions, pharmacies and suppliers providing access to high-quality healthcare services
    - **(4)** A high degree of interaction between the public and private healthcare delivery systems is necessary to various support programs, such as the Wounded Warrior Project which provides care for the severely injured active service members and veterans
- **b.** MHS healthcare professions provide care and treatments in a variety of geographic and technical environments
    - **(1)** The community of care system is an interwoven network of 52 "brick and mortar" inpatient hospitals and medical centers; 15 facilities are located in foreign countries
    - **(2)** The MHS has over 640 ambulatory surgery/outpatient care clinics and dental clinics. Health Information Technology (HIT) legacy systems and emerging technology are utilized in stateside medical treatment facilities, such as hospital and clinics, and overseas in austere battlefields facilities, tents, hospital ships, and aircrafts used for patient evacuations and aeromedical transport
- **c.** The various locations and facilities add to the complexity and challenges of using information technology for clinical care
    - **(1)** Consequently, Tri-Service nursing informaticists may find themselves practicing in the traditional hospital settings, in nontraditional settings aboard Navy vessels such as the USNS Mercy or USNS Comfort, on a forward-deployed battlefield, in a humanitarian mission, or recovery support mission from a natural disaster
    - **(2)** A few of the many humanitarian missions include operations during the 9/11 attacks in New York; relief to those impacted by Hurricane Katrina in New Orleans; and to the response and recovery efforts of the earthquake survivors in Haiti

4. Department of Veteran Affairs (DVA) landscape

- **a.** The primary mission of the Department of Veterans Affairs (VA) is to maximize the veteran's activities of daily living throughout the continuum of care
    - **(1)** The VA is comprised of an integrated healthcare system reaching across all 50 states and several US Territories, with an eligible population of 22 million veterans of which 8.8 million are enrolled at VA facilities
    - **(2)** In 2013, the VA had over 151 acute care hospitals and 827 Community Based Outpatient Clinics (CBOC). Daily, the VA sees over 200,000 outpatients, 6000 emergency room visits, and has an average inpatient census of nearly 11,000
    - **(3)** A unique entry point into the VA is through "Vet Centers," which are community-based outreach clinics, where both active duty and veterans can access healthcare benefits including individual and family counseling and educational benefits
- **b.** Currently, VA has over 59,000 full and part time professional nurses; 283 are recognized as informatics nurses
    - **(1)** The VA is known for providing world-class healthcare and is also a leader in informatics and successfully developing information technologies

Teaching Tip
Inform the students that Computerized Patient Record System (CPRS), Bar Code Medication Administration (BCMA), and Personal Health Record (PHR) are discussed later in the chapter. Telehealth and Telehomecare is increasingly used to provide care to veterans.

5. Department of Health and Human Services (DHHS) landscape

- **a.** The DHHS is charged with protecting the health of the American public and providing essential human services, such as Medicare and Medicaid
    - **(1)** Within DHHS, the US Public Health Service (USPHS) has programs dedicated to
        - **i.** Disease prevention and control
        - **ii.** Biomedical research
        - **iii.** Food and drug protection as well as medical device safety

            iv. Mental health and substance abuse management
            v. Healthcare system and resource enhancements
            vi. Medical care for underserved and special needs populations
        (2) The USPHS Commissioned Corps of uniformed public health professionals respond to public health needs and to advancing the science of public health practices
        (3) Many of the USPHS scientists and clinicians were involved with early research studies and innovations in information technology
    b. The Office of the National Coordinator (ONC) has the distinct role, under DHHS, to oversee national eHealth programs including the adoption and implementation of electronic health records
        (1) In particular, the Agency for Healthcare Research and Quality (AHRQ), the National Institutes of Health (NIH), and the National Library of Medicine (NLM) provide research funding supporting the development of clinical informatics and emerging healthcare technologies
        (2) An enormous number of innovations and computer programming technologies received federal grant investments from these agencies

6. A snapshot of nursing informatics pioneers in the federal sector
    a. The genetic strands of the nursing profession can be traced back to the Crimean War, where Florence Nightingale cared for the soldiers in the battlefields and Clara Barton founded the American Red Cross
        (1) Both Nightingale and Barton proved to be early informaticists, as evidence through their documentation practices and use of data for early statistical documentation that can be thought of as the "big data" of the 1800s
    b. A number of contemporary informaticists started their professional nursing careers as military officers or federal public health commissioned nurses
        (1) In the 1950s, Army nurse Lieutenant Colonel (Ret.) Harriet Werley served as a nurse researcher at Walter Reed Army Institute of Research. Her studies included data processing initiatives with IBM and was instrumental in the development of the Nursing Minimum Data Set (NMDS)
        (2) Retired Army Colonel Nancy Staggers, another important military nurse informaticists, earned the first PhD in Nursing Informatics from the University of Maryland and conducted research on human–computer interactions and system usability studies
    c. Within the USPHS Commissioned Corps, Virginia Saba, Kathleen McCormick, and Carol Romano were nursing officers who leaned forward and spearheaded nursing informatics into the 21st century
        (1) Dr. Saba promoted the use of computer technology to solve problems in administration, education, research, and clinical nursing practice
        (2) Dr. Kathleen McCormick began her informatics career at the NIH as an informatics scientist and clinical trial researcher
            i. She conducted early nursing informatics initiatives and achieved major advances in nursing informatics including the development of the Computerized Clinical Decision Support program for the AHRQ
        (3) Dr. Carol Romano is highly recognized for the design and implementation of one of the first computerized medical information systems in 1976
        (4) The 21st century federal nurse informaticists have greatly expanded in scope because of the early efforts and innovations in computer technologies

7. Historical landmarks in federal technological advancements
    a. The journey to nursing informatics as we know it today started in the 1970s with key military and federal innovations and initiatives in computer programming and applications
        (1) Early studies at the AHRQ led to healthcare system development to include nursing care planning and clinical documentation
        (2) Simultaneously, the DoD designed one of the first clinical computer systems known as the Tri-Service Medical Information System (TRIMIS)
        (3) In the mid-1970s and early 1980s, both the DoD's Composite Health Care System (CHCS) and the VA's Veterans Health Information Systems and Technology Architecture (VistA) developed similar but distinct "government off the shelf" (GOTS) electronic medical records using the Massachusetts General Hospital Utility Multi-Programming System (MUMPS) programming language
        (4) In the 1980s, the VistA information system was legally declared as open source technology and was available for unrestricted use within both the public and private sector
        (5) The federal sector was also responsible for the development of national reference databases such as the NLM Medline and most recently the software-licensing program of SNOMED for both public and commercial entities

8. Federal legislative role in nursing informatics
    a. The federal government plays a critical legislative role in the emergence of healthcare informatics in both the public and private sectors
        (1) The primary goal is to share healthcare information
        (2) Healthcare reform laws and regulations enacted by Congress expanded the opportunities for nurses to work outside of clinical practice, and to engage in emerging roles like information management and technological
        (3) The roles of nursing informaticists were incorporated into healthcare policy, research, consultation, academia, and computer applications
        (4) The federal laws are mandated for public healthcare organizations, it usually results in early adoption of information technology
        (5) These mandates often "pushed" to multiple federal agencies to develop and implement new or immature technology

Teaching Tip

Provide this as an example, in 2004, Executive Order (EO) 13335 advanced the development, adoption, and implementation of HIT standards nationally through collaboration among public and private interests. This mandate provided authority for both public and private healthcare sectors to forge partnerships to established interoperable HIT standards and technologies.

Chapter Overview

1. Overview
   - **a.** The remainder of the chapter discusses the evolution of nursing informatics roles, responsibilities, and competencies in multiple federal agencies
     - **(1)** The major information management and technological milestones within specific federal agencies are presented
     - **(2)** Finally, the major challenges facing nursing informatics and HIT in the federal health sector are discussed
2. Federal nursing informatics roles and responsibilities
   - **a.** Nurses in the federal sector have been influential leaders in Health Information Technology (HIT) and informatics for decades
     - **(1)** Federal leaders in nursing informatics made significant contributions to the profession and led various aspects of design, testing, implementation, training, and support for a diverse range of clinical information systems and technologies
     - **(2)** Federal entities were early adopters of electronic health records (EHR), computerized provider order entry (CPOE), administrative HIT applicative to include workload management and clinical documentation systems
     - **(3)** With the rapid proliferation of HIT, federal nursing informatics specialists continue to be indispensable leaders in the advancement of healthcare in our nation as evidenced by their high level of involvement, adaptability, and management skills
   - **b.** Federal agencies embrace the role of nurses within HIT, but standardization and formalization of nursing informatics roles and responsibilities are at various stages of maturity within each of the federal agencies
     - **(1)** Today, federal informatics nurses serve in roles ranging from direct patient care, where informatics is an additional duty, to that of the expert Informatics Nurse Specialist (INS), serving in enterprise level leadership
     - **(2)** Significant efforts have been made to formalize and standardize the role of the INS within the federal agencies
     - **(3)** Regardless of the maturity level of the organization with regards to INS role development, INSs are actively engaged throughout all levels of the organization
   - **c.** Many nurses within the federal sector started their informatics career by serving as a functional representative or "super user" during the development, training, and implementation of an HIT system or application
     - **(1)** The responsibilities of the federal nurse informaticist include systems development and implementation, privacy and safety measures, quality initiatives, and informatics education
     - **(2)** Under various titles, these experts typically lead or participate in key informatics, documentation, or quality meetings at the facility level, and the level of education and formalization of positions varies between federal services
   - **d.** The VA and DoD MHS support various forms of nursing informatics involvement at the leadership or strategic level of the organization
     - **(1)** Federal nursing informaticists can assume roles such as Chief Medical, Health, or Nursing Information Officer; Chief Information Officer; or clinical informatics consultant
     - **(2)** The INS serves as an expert advising authority with regards to all HIT-related issues, and many are involved in the strategic development of numerous initiatives to include informatics workforce development; HIT acquisition, governance, and budgeting; management of clinical systems; policy and program development; workflow analysis and development
   - **e.** The federal sector also presents unique INS opportunities largely due to the large size of the organizations and the unique missions
     - **(1)** Regardless of role or title, nurses with informatics education and training utilize their skills in every healthcare setting, to include military deployments within a combat zone
     - **(2)** Recently, DoD initiated research on the role of deployed nurse informaticists which resulted in pilot projects for studying overseas combat deployment positions and which may lead to authorizing formal positions for INSs within these environments
     - **(3)** The spectrum of career broadening opportunities for federal INSs ranges from data analysis and business intelligence to that of managing the acquisitions and programs for new "cradle to grave" clinical systems
   - **f.** Federal agencies build on the foundations established decades ago from early federal informatics nursing leaders by continuing to formalize the roles and responsibilities of the informatics nurse
     - **(1)** In the microcosm of the federal government, it is possible to realize the significant potential of an integrated healthcare system
     - **(2)** The collaborative nature between and among the different federal agencies have allowed our nursing informatics leaders to learn from the various roles and responsibilities, especially as the roles evolve to ensure the successful development, implementation, and sustainment of our future national electronic health records systems
     - **(3)** Today, the federal agencies continue to work together to build a professional roadmap that will meet the needs of new HIT systems, while providing the most effective, safe delivery of quality healthcare for our military service personnel and veterans
3. Federal nursing informatics competencies
   - **a.** The development and implementation of federal nursing informatics competencies has followed an organizational- and facility-specific path
     - **(1)** The Army chartered a comprehensive and methodological approach to competencies for healthcare workforce, including nurse informaticists
     - **(2)** Their strategy documents several role-specific competencies for each identified role such as the CMIO, clinical workflow analysts, and clinical systems trainer
     - **(3)** The strategy also included specific role profiles, integrating position description with competencies for the position

   - **(4)** Unique in the workforce-level plan are metrics for proficiency growth, satisfaction, and mentorship, providing valuable feedback for strategy update, refinement, and application
- **b.** VA nurses practice in a wide array of informatics-related positions such as Clinical Applications Coordinator, Bar Code Medication Administration Coordinator, Data Analyst, Researcher, Software Development and Portfolio Manager, Terminologist, and Informatics Educator
   - **(1)** VA healthcare informatics career development strives toward developing a common base of competencies integral for all health informatics roles, which further supports the multidisciplinary professional arena in which they practice
- **c.** The Air Force is currently exploring organized structure options for the future of INS. The current competencies are related to the clinical informatics consultant roles embedded within the Headquarters of the Air Force
   - **(1)** Supporting the Office of the Chief Information Officer, these competencies include collaboration in new technology life cycle development, policy formation, deployment of technologies, and business practice optimization
   - **(2)** These competencies ensure the nurses are engaged in the strategic implementation of HIT initiatives with the beginnings of operational considerations in workflow analysis and tools that align with business practice optimization
- **d.** Navy's approach to nursing informatics competences takes a more local, facility-specific way to identify and built the required roles and competencies to include common training resources from the American Nurses Association, HIMSS, ONC, etc.
   - **(1)** Frequently the education of the nursing informaticist was based on individual career objectives and resulted in the nurse obtaining a graduate certificate in informatics from an accredited university, informatics certification via the American Nurse Credentialing Center or HIMSS, or acquiring new knowledge from such courses as American Medical Informatics Association's 10×10 offering
   - **(2)** Competencies for these positions were not centralized and were often integrated into position descriptions, making translation and comparison a challenge
   - **(3)** Navy medicine is actively developing the role and training paths for future implementation

4. Professional career development

- **a.** The federal healthcare space consists of an array of career paths and workforce maturity for informatics nurses
   - **(1)** However, the federal sector shares the commonality of informatics being a transforming career creating multiple new and unique opportunities in leadership and management of change
- **b.** One example of new career paths stems from the VA baseline assessment of the "State of the informatics workforce in 2011"
   - **(1)** The results assisted in developing a comprehensive workforce roadmap to develop health informatics competencies, career paths, and communities that prepare the VA informatics workforce to engage in this transformation
   - **(2)** Findings portrayed a VA informatics workforce that was primarily rooted in informal informatics preparation or training that consisted of self-trained individuals
   - **(3)** At the time of the study, the workforce did not have clearly defined position descriptions or career paths and the healthcare professionals struggled to define and describe their role within the organization
   - **(4)** As a result, several workforce development efforts have been implemented to address these deficiencies to include an online course, "Introduction to Health Informatics," that is based upon the ONC informatics curriculum and offered in partnership with Washington State Bellevue College
   - **(5)** Additional VA efforts include a health informatics video lecture series, and a health informatics certificate program aimed at training thousands of clinicians in applied health and medical informatics within 10 years called AMIA 10×10
- **c.** Similarly, the Department of Defense has a rich history of informatics experience
   - **(1)** Army medicine formalized the role of the CMIO in 2008, establishing processes and a workforce structure to support clinical informatics and HIT operations within the Army
   - **(2)** With the establishment of the CMIO, the leadership successfully obtained authorization for a multidisciplinary informatics skill identifier for the clinical informatics workforce
   - **(3)** The skill identifier for nursing requires a Master's degree in informatics, completion of an Army specific functional proponent course, and two years of healthcare informatics experience
- **d.** Navy medicine recently began to identify positions for nurse informaticists
   - **(1)** The informatics positions are frequently inherent collateral duties embedded to the nurse's primary responsibilities and role
   - **(2)** Informatics roles are often specific to the organization's current HIT needs, whether it is implementation of the electronic health record, intranet or patient portals, or facility-specific systems for patient acuity and nurse staffing
   - **(3)** Several headquarters and specialty command positions do provide full time nursing informatics positions in clinical informatics
- **e.** The Air Force similarly identified the need for specialty training and focused career broadening experience in nursing informatics
   - **(1)** In 2011, the Air Force began the nurse informatics fellowship program
   - **(2)** In 2013, the clinical informatics consultant positions were realigned, which ultimately created a path at the enterprise and facility level
   - **(3)** The tactical level continues to be developed, as those nurses are involved as "super users" and in working groups that serve as additional duties based on interest

- **(4)** The Air Force continues to look at the precedent set by the other federal partners and national organizations as it builds a path that meets the Air Force INS needs for the future

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Evolution of Technology

1. Overview

- **a.** The Department of Defense (DoD) and the Department of Veterans Affairs (VA) have been leaders in the development and implementation of electronic health records
  - **(1)** The federal health sector provides a wide range of services to active duty service members, National Guard, Reserve members, veterans, retirees, and their families
  - **(2)** Multiple environments and tools actively support developing interoperable systems, as result clinical documentation linking the continuity of care faces many unique challenges

2. Department of Defense

- **a.** The evolution of the EHR, for the DOD MHS, began in 1987 with the government owned Composite Computerized Healthcare System
  - **(1)** Deployed in the 1990s, CHCS was a first generation EHR and supported physician order entry
  - **(2)** A nurse's role in using this system was to check or validate physician orders and result retrieval of laboratory and radiology results
- **b.** CHCS continues to provide different patient views depending on user roles; clinicians are able to view a patient's current and past medical history and medications
  - **(1)** Other outpatient functions include verifying eligibility for care and scheduling appointments
- **c.** In 1988, the first application of a commercially developed inpatient record called CIS (Clinical Information Systems) later to be known as Essentris was implemented at an MHS facility
  - **(1)** Initially the inpatient documentation was aimed at labor and delivery units and the ability to capture the wave forms from mothers in labor; meeting the critical need to capture and store wave forms, where traditional wax encoded strips deteriorated
  - **(2)** System deployments then moved to the critical care units and eventually into the other inpatient units
  - **(3)** By 2011, all 58 MHS inpatient facilities worldwide had Essentris installed and implemented
- **d.** The MHS began to explore options for an updated electronic documentation process for recording clinician outpatient encounters
  - **(1)** By late 1998 a third version of a concept of operations for CHCS II (Composite Health Care System II), later to be called AHLTA was being circulated
  - **(2)** In 2004 the deployment of AHLTA, the DoD's global EHR, made it the largest ambulatory EHR in the world with a single clinical data repository (CDR), serving over 9 million beneficiaries
  - **(3)** AHLTA provides a secure, standards-based, enterprise-wide medical information system that generates, maintains, and provides 24/7 access to the electronic health records of active duty military, their family members, and others entitled to DoD healthcare
  - **(4)** Lastly, in 2012 the MHS deployed a Secure Messaging system, similar to e-mail, to communicate with outpatient community
  - **(5)** The Air Force took the Secure Messaging system one step further and added a Personal Health Record feature to this system
- **e.** AHLTA offered staff a new capability for decision support and predictive analysis through data mining as a result of healthcare providers using a structured taxonomy for writing clinical notes and the capture of the data in a central repository
  - **(1)** This data mining used automated computational and statistical tools and techniques to evaluate and analyze large data sets and assist predicting potential disease/illness patterns
  - **(2)** AHLTA provides informatics nurses with the ability to search the repository for previous outpatient encounters within the MHS and the ability to retrieve patient data prior to a scheduled outpatient appointment or conduct a follow-up based on care documentation
  - **(3)** Some patient information available includes: vital signs, allergies, medications, demographics, past medical history, previous encounter notes, problem lists, and lab results
- **f.** AHLTA captures information in the fixed facility outpatient environment
  - **(1)** The ability to document care onboard ships and within the operational field was later developed to meet the specific needs of the remote/mobile environment
  - **(2)** AHLTA-Mobile was designed to capture information on a handheld device and store first responder clinical documentation. Initial injury and illness clinical documentation is then transferred to AHLTA-Theater (used in remote locations) and onto the Theater Medical Data Store (TMDS)
  - **(3)** Unique features of the mobile application allow for operations in no to low communications environments, ability to pre-populate demographic data
  - **(4)** AHLTA-Theater has the same user interface look as AHLTA and operates in a stand-alone environment utilizing a store and forward capability updating information when connected to a network and eventually updating the AHLTA CDR
- **g.** A system of considerable note for the deploying forces is the Theater Medical Information Program-Joint (TMIP-J)
  - **(1)** It is a multi-Service automated system that integrates sustaining bases medical applications for use by deployed forces including all of the variations of AHLTA, CHCS, Defense Medical Logistics Standard Support (DMLSS)
  - **(2)** The system provides an EHR, medical command and control, medical logistics, and patient movement and tracking for the theater environment

3. Department of Veterans Affairs
   a. The VA dates its computerization efforts back to the early 1980s with the advent and subsequent deployment of Decentralized Hospital Computer Program (DHCP) across the VA enterprise
      (1) Locally developed applications helped evolve DHCP as new needs and technologies emerged to greatly enhance patient care. DCHP integrated overtime and evolved into the Veterans Health Information Systems and Technology Architecture (VistA)
      (2) VistA is deployed universally across the VA at more than 1500 sites of care, including each Veterans Affairs Medical Center (VAMC), Community Based Outpatient Clinic (CBOC), Community Living Center and at nearly 300 VA Vet Centers
      (3) A key to the evolution of VistA was the development and deployment of the Computerized Patient Record System (CPRS)—a graphical user interface (GUI) that interacts with the VistA common functions and integrated applications via reusable interfaces
      (4) VistA, CPRS, and a variety of other VistA-based applications support day-to-day clinical and administrative operations at local VA healthcare facilities
   b. In 1992, a registered nurse from the Topeka Kansas VAMC was returning a rental car, and wondered if rental cars could be barcoded and scanned why not medication?
      (1) This was the origin of the development of Bar Code Medication Administration (BCMA)
      (2) As a component of the VistA-based electronic medical record and CPOE, the VA implemented BCMA in 1999
      (3) Since its inception, BCMA has moved through several versions to evolve into sophisticated solution-driven clinical software
      (4) Nurses have continually assisted in the design of the software
      (5) Nurses continue to provide input to the software development to create a safe environment for practicing nursing and for ensuring patient safety and to expand the use of the software to other clinical scenarios such as lab, blood bank, and clinical inventory
      (6) Additionally, the Indian Health Service (IHS) Office of Information Technology (OIT) Electronic Health Record (EHR) Deployment Team, Veterans Health Administration's (VHA) Bar Code Resource Office (BCRO), and VA's OIT continue efforts for BCMA implementation to expand the patient safety benefits of BCMA into IHS and tribal facilities through partnering agreements
   c. My HealtheVet is another key component of the VA's evolution of technology
      (1) My HealtheVet (MHV) is the official Personal Health Record (PHR) of the Department of Veterans Affairs. MHV offers enhanced online health tools, services, and resources for both the user and clinician 24/7 and 365 days per year
   d. The VA continues to address the evolution of technology, recognizes the contribution of the Open Source community in the future of Electronic Health Records, and was instrumental in the establishment of the Open Source Electronic Health Record Agent (OSEHRA)
      (1) The VA has enlisted OSEHRA to develop future enhancements to VistA
      (2) This decision was part of a joint effort with the DoD to store all veterans' and service members' health records electronically using a single source as part of the Department's pioneering activities in the OSEHRA community, VA has contributed the VistA code to the OSEHRA effort
   e. Within the VA, the development of the next generation Electronic Health Record Evolution has been linked to multiple efforts
      (1) In 2009, President Barack Obama charged the Departments of Veterans Affairs (VA) and Defense (DoD) to "work together to define and build a seamless system of integration" of electronic health records (EHR)
      (2) In 2011, the VA and DoD Secretaries committed to developing a single, joint, common, interagency Electronic Health Record (iEHR) by 2017
      (3) This approach was intended to overcome certain challenges to system interoperability
      (4) In early 2013, the Departments recognized increased costs and risks associated with the initial implementation path and proposed a new strategy
      (5) The Departments' redefined efforts as seamless sharing of interoperable health data between EHR systems
      (6) Under this new framework, with continued emphasis on interoperability, each agency is responsible for its own EHR system
      (7) VA has committed to use existing VA Health Information Systems and Technology Architecture (VistA) and incrementally deliver new functionality through a VistA Evolution Program
      (8) The mission of the program is to advance the VistA technical platform to promote improved outcomes to quality, safety, efficiency, and satisfaction in healthcare for Veterans through supporting patient-centered team-based care, enhancing clinical reasoning, and providing EHR system interoperability with the DoD and other healthcare partners
4. Interoperability between the DoD and VA
   a. An additional concept to discuss regarding breakthroughs in technology is the interoperability data sharing initiatives between the DoD and the VA
      (1) Here is an overview of some of the most widely used efforts, which will be expanded on in the section on challenges
   b. The Federal Health Information Exchange (FHIE) Program was the initial interagency initiative between the (DoD) and (VA) enabling a secure, one-way transmission of protected electronic health information from DoD to VA on service members who had separated from the Armed Forces
      (1) FHIE uses existing clinical systems and began populating the VA repository in 2002
      (2) As more patients began to seek care from both the DoD and VA simultaneously the need for a bidirectional

exchange of data in real time created the Bidirectional Health Information Exchange (BHIE)

    (3) BHIE utilizes a middleware, hardware, and software framework that provides a secure, bidirectional, real-time interagency exchange of clinical data and patient demographics between the DoD and VA health information systems

    (4) Once again driven by the need to improve patient safety for those patients seeking care from both the DoD and VA the Clinical Data Repository/Health Data Repository (CHDR) initiative emerged

    (5) CHDR consists of an interface between DoD's Clinical Data Repository (CDR) of AHLTA and VA's Health Data Repository (HDR). CHDR enables the bidirectional exchange of computable outpatient pharmacy and medication allergy data and enhances decision support by cross-referencing drug–drug and drug–allergy interactions

    (6) CHDR was an important step forward toward "interoperability" and represented a departure from "viewable" data

c. One last initiative on interoperability is the Virtual Lifetime Electronic Record (VLER)

    (1) Not confined to just data sharing between the DoD and VA but involves the exchange of data between private healthcare providers

    (2) This is a multifaceted business and technology initiative that includes a portfolio of health, benefits, personnel, and administrative information sharing capabilities

    (3) This functionality provides Veterans, Service members, their families, care-givers, and service providers with a single source of information for health and benefits needs in a way that is secure and authorized by the Veteran or Service member

    (4) When VLER is fully implemented, all information needed to quickly and accurately provide services and benefits to our Veterans and Service members will be exchanged electronically and proactively, putting the right information in front of the right people at the right time for them to take action

d. The DoD and VA have been early adopters of technologies and in many cases have pushed the nation in the direction of adopting electronic medical records

    (1) This section has focused on some of those technologies driven by the needs of the battlefield and enroute care of the service member and the long-term care provided by the Veterans Administration

    (2) The next section will focus on some of the challenges the DoD and VA have overcome to continue to improve the delivery of healthcare to those they serve

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Challenges

1. Overview

a. The remainder of this chapter focuses on some of the unique technical and business challenges that are part of the federal healthcare space

    (1) One of the earliest examples of the contributions of the DoD to the information age was the development of the Advanced Research Projects Agency Network (ARPANET)

    (2) In 1966 the Defense Advanced Research Project Agency (DARPA) contracted with individuals in Cambridge, Massachusetts on a project to create a wide area network

    (3) Using packet switching technology it became the first nationwide digital network and connected academic computer centers working on DoD projects

    (4) By 1972 a total of 29 educational institutions were linked to one computer in the DoD

    (5) Hence the start of "internetworking" as it was originally known or the Internet

    (6) However, once other computer networks began connecting to the network the military's concern for security caused them to break off their segment forming the MILNET in the early 1980s

b. Security concerns in relation to the network became even more important to the DoD and now represents one of the unique challenges setting them apart even from the VA

    (1) The DoD has the obligation to secure not only protected health information (PHI) or personally identifiable information (PII), but the sensitive data residing on the same network as information considered sensitive but unclassified and is intended for official use only (FOUO)

    (2) From the original MILNET the DoD now operates two separate segments, the Non-classified Internet Protocol (IP) Router Network (NIPRNet) carrying FOUO information for DoD customers to provide "protected access to the public Internet" and the Secret Internet Protocol Router Network (SIPRNet) which carries classified data

    (3) The classified data may include healthcare data from the battlefield

c. Although the VA and all federal agencies have the same need to protect PHI and PII just as any private or commercial entity, the uniqueness of the military mission of the DoD creates additional layers of security and strict requirements are in place for personnel to access the network

    (1) Information Assurance (IA) is a risk management function to protect information management and information technology (IM/IT) investments by assuring the Confidentiality, Integrity, and Availability (CIA) of information

    (2) In order to do so, the DoD establishes enclaves or a collection of computing environments or services under the control of a single authority or security policy, including personnel and physical security

    (3) This may create conflicts with entities, which follow different security policies than the DoD such as the

VA and Office of the National Coordinator for Health and Human Services (ONC/HHS) for National Health Information Exchange (HIE)

d. Any IM/IT capability logically crossing the boundaries of an enclave such as data transfer or exchange requires an "Authority to Connect" (ATC) across that boundary

(1) Across the DoD, there are constraints regarding what policies apply to what type of boundary such as another military service, another agency such as VA, or the Internet

(2) Access by a user directly to data in that enclave requires the use of approved access request processes and technical controls

(3) This includes requirements/constraints, which may not be owned by IM/IT

(4) Examples include: background investigations, need to know, management of Foreign Nationals, etc.

(5) The challenge to deploying any new software becomes the time involved in making sure that the application and/or system has been properly assessed and permission has been granted to allow access for that system to be connected to the network and can take six months or more, putting a deployment beyond the scheduled start date if these activities are not considered as part of the entire project management plan

e. The connectivity to shore-based applications from onboard ships, remote, and geographically austere locations is another challenge

(1) Developing applications with the ability to store and forward data when connectivity is available via secure channels from a deployed environment is a way to overcome this challenge

(2) Satellite availability is devoted to ship operations and combatant commanders in the field taking priority over medical operations

(3) Conducting operations with minimal Internet capability, referred to as low or no communications environments, is similar to what healthcare providers in rural areas may experience in remote areas where even cell reception is problematic due to the lack of penetration of wireless networks

2. Funding

a. The ability to fund medical care, including the buildings, people, services, equipment, etc. in the federal government is not the same as in the private sector and may introduce new challenges to the informatics nurse

(1) An appropriations bill, which is a legislative motion passed by Congress is necessary before any government agency can spend money

(2) Appropriations are used to fund discretionary programs and are generally approved on an annual basis

(3) This also means that any funds appropriated must be spent or obligated by the end of the fiscal year and cannot be carried over from year to year

(4) If Congress has not passed a new appropriation then an appropriation bill called a continuing resolution may be passed which allows for continued spending for a short period of time at the same rate as the previous year

(5) If there is no appropriation the government faces an Anti-Deficiency Act violation if they try to spend money on any activity for which there is no appropriation

b. For the DoD, the National Defense Authorization Act voted on by Congress gives the DoD the ability to spend money and provides specific instructions for the funding. In the H.R. 4310 (112th): National Defense Authorization Act for Fiscal Year 2013 (House of Representatives, 2012) the act divided funding into divisions in which the Department of Defense Authorizations was one of four divisions

(1) Based on these appropriations the breakdown of funding for health information technology is a part of the Defense Health Programs (DHP) budget and is later divided into one of eight categories to include HIT

c. The DHP Appropriations for just the health information technology consists of Operation & Maintenance (O&M), Procurement and Research, Development, Test & Evaluation (RDT&E) funds

(1) Some primarily deployable healthcare activities and research functions are funded by the Military Departments of the Army, Navy, and Air Force through their O&M, Procurement, RDT&E, and Military Personnel (MilPers) appropriations

(2) The health plan comprises the largest portion of the Defense Health Programs budget and is a significant amount of money in the overarching Defense budget

(3) Information Technology (IT) is a smaller portion of that, making the challenge between how to drive efficiencies in spending on sustainment of the budget for HIT and create room for modernization

(4) Many of the HIT projects are created with initial funding as special projects, but the sustainment is rarely funded at the same time causing funding deficits into the future

d. Whereas the DoD requires annual appropriations, the VA has some two-year appropriations

(1) The (VA) Budget is also apportioned into six program areas

(2) Two areas are related to informatics, the first is Medical Care Programs, which funds a broad range of primary care, specialized care and related medical and social services, including education and training for physician residents and other healthcare trainees and medical research and development

(3) The second area is Information Technology, which funds operations and maintenance, staffing, and development

(4) The Assistant Secretary for Information and Technology controls the IT appropriation for information and technology

e. The centralized model for HIT funding is unique among federal agencies as many of the other agencies organize HIT funding by business lines

(1) This impacts the degree to which individual Administrations such as Health, Benefits, and Memorials influence and control funding decisions for HIT projects

(2) Prioritization of HIT funding is based on decisions reached by VA leadership and the HIT governance boards, and is based upon the VA Strategic Plan and Agency Priority Goals

 (3) Prioritization is accomplished across the three principal subcategories of
 i. Pay and administrative funding which funds the HIT staff and covers overhead costs of program management, mandatory sustainment and information security which includes necessary but noncritical sustainment efforts to continue or enhance the Office of Information Technology (OIT) operations
 ii. Development, including marginal sustainment, to cover development, modernization, and enhancements of projects

f. More than half of the appropriation covers expenses for mandatory sustainment and information security, which fund the VA's HIT infrastructure, including computer, hardware, software maintenance, networks, and phone systems at all the VA hospitals, outpatient clinics, regional benefit offices, and cemeteries
 (1) Spending for staffing and administration is the second largest category; together, these compromise almost 75% of the HIT budget
 (2) Development and other minor needs comprise the remainder of the HIT budget. VA is challenged with increased sustainment costs, which increasingly limit the funding available for developmental needs
 (3) This is due in part to the recent additions of HIT products without a commensurate removal of older legacy systems
 (4) Determining a divestiture strategy is a key driver in HIT program planning for the near future

g. VA is also challenged with the extra effort required to program funding for HIT needs where there is a difference between Veterans Health Administration (VHA) funding and HIT funding
 (1) VHA receives two-year advance appropriations for some of their medical care appropriation accounts (Medical Services, Medical Support and Compliance, and Medical Facilities)
 (2) This affords more stable planning and programming, but can cause difficulties when HIT is only funded with one-year appropriations

3. Standards and interoperability
 a. Interoperability is a key part of sharing data and there are a number of activities focused on creating interoperable standards
 (1) As noted in the previous section DoD and VA have a number of data sharing initiatives, from viewing data such as through FHIE and BHIE to actionable data that triggers decision support via CHDR
 (2) To achieve computable semantic interoperability, both agencies standardize their data for each given clinical domain (pharmacy, allergy, etc.) and exchange the standardized data through the interface
 (3) DoD and VA standardized data are "mediated" by way of an agreed upon "vocabulary" that enables DoD and VA to use each other's data in decision support applications
 (4) For medications, the mediation terminology used is RxNorm. For non-medication allergies the UMLS CUI is used for mediation
 (5) For Signs and Symptoms or reactions related to Allergies, SNOMED-CT is utilized
 (6) This data mapping can be time consuming and never-ending

 b. The issue is not unique for the federal partners but the early adoption of data exchanges between the DoD and VA lead to increased awareness of the need to engage with the organizations that develop healthcare-related data exchange standards
 (1) Over the years, the DoD and VA along with many of their civilian partners have been very active in implementing standard terminologies and ontologies

Teaching Tip

Provide the example, Ryan Bosch, MD from INOVA Health System pointed out that simply linking the 5000 physicians in his system was very difficult due to the proprietary nature of the different labs each facility uses. This scenario highlights that data mapping challenges. Moving away from data mapping to open standards using standardized terminologies will decrease the reliance on proprietary data schemes within electronic health records. The integration of industry definition, codes/terms, and the regulation of medical devices that now attach to hospital networks is a maturing process for healthcare as a business, public or private.

 c. Introduced in 2007, the International Health Terminology Standards Development Organization (IHTSDO) was established to develop, maintain, promote, and enable the uptake and correct use of its terminology products in health systems
 (1) The IHTSDO Workbench provides terminology content modelers with a set of tools to author, map, search, browse, and classify terminology, plus undertake workflow and process automation
 (2) The VA has since undertaken efforts to enhance and extend the IHTSDO Workbench to bolster performance and functionality, improve the general user experience, and promote cooperative modeling of normalized content

 d. There are a number of joint partnerships between the DoD Informatics community and the VA along with civilian partners in private industry
 (1) They are engaged in data mapping and interoperability and have members on various working groups within many of the standards organizations working to drive the nation toward an interoperable, standardized nomenclature
 (2) Some of the efforts with Health and Human Service and the Office of the National Coordinator for Health Information Technology have led to the refinement of the data exchange needed for the virtual lifetime electronic record (VLER)

 e. The DoD and VA have also been active participants in many of the more well-known standards development organizations driving nationals standards to improve the exchange of information not only from DoD to VA and back, but with commercial partners

   - **(1)** Some of these bodies include the Health Level 7 (HL7) Standards Organization where the formatting and data terminologies and ontologies are being specified; the Logical Observations Identifiers, Names, Codes (LOINC) work group, and SNOWMED-CT which defines clinical terminology and a universal standard for identifying laboratory results and other clinical observations
   - **(2)** The ability to exchange laboratory results data since 1994 is a great step in the right direction, but more work is needed in this area on the actual sending and receiving of the tests as these remain within the proprietary language of the system being used at a given facility

4. Size and complexity
- **a.** The initial section of this chapter provided details on the number of facilities and the different environments within which the federal partners work
   - **(1)** One of the unique challenges is the geographically dispersed federal sector facilities
   - **(2)** The DoD manages hospitals and clinics around the world with staff working in all 24 time zones creating a time management challenge
   - **(3)** Similarly, the VA has clinics in some locations located near former military installations such as in the Philippines and Puerto Rico and some in current locations such as Guam
   - **(4)** The Coast Guard has a much further reach than our continental coast, including remote locations from Alaska to Hawaii and supporting maritime safety where US Navy ships are located such as foreign ports like Kuwait Naval Base
   - **(5)** As for the United States Public Health Service (USPHS) officers who are charged with the health of the entire US population they serve alongside the military on board ships, in Military Treatment Facilities (MTFs), or public sector partners during time of national disasters such as flood and fires
   - **(6)** Caring for patients utilizing these scattered and diverse networks are a challenge both logistically and physically
- **b.** Each agency has specific medical missions that drive their requirements for healthcare in these diverse locations
   - **(1)** In order to sustain a fit and medically protected force the DoD operates preventative medicine facilities in undisclosed locations on seven continents
   - **(2)** A secondary mission for the DoD is to provide a full-service hospital asset for use by other government agencies involved in the support of disaster relief and humanitarian operations worldwide
   - **(3)** This is handled by the hospital ships which were discussed earlier
   - **(4)** The VA's healthcare mission covers the continuum of care by providing inpatient and outpatient services, including pharmacy, prosthetics, and mental health; long-term care in both institutional and noninstitutional settings and other healthcare programs such as readjustment counseling

5. High-level requirements and approval process
- **a.** The federal agencies have a prescribed governance process beginning with high-level requirements from the functional community that can come from either the clinical or business owners
   - **(1)** For the DoD these requirements are in response to the strategic goals of a medically ready force and a force that is medically ready to deploy
   - **(2)** Once a decision is made that the need cannot be satisfied by a policy change and a material solution is necessary, the needs are vetted with the technical communities for potential approaches to meet the requirement
   - **(3)** Then a decision is made to add those requirements to a system that already exists or modernize the system, buy a commercial product, or develop the material solution from the ground up
   - **(4)** IT must remember that they support the end user and rely on the functional proponent to set the requirements
- **b.** Decisions on HIT spending follow the MHS governance processes, which include the military services (Army, Navy, and Air Force) for all clinical and business systems
   - **(1)** The ability of a single Service to individually decide to field a system or application to meet a service-specific need has been reduced to sustaining only what is currently in their portfolio of activities
   - **(2)** Any new system or changes to an existing system must now be a collective discussion concurred on by all the Services before money is spent on any project in sustainment or a new program or change to an existing program is initiated
   - **(3)** Prior to funding any expenditure in any given year the money has to be certified by the Deputy Chief Management Officer (DCMO) that the money will actually be spent in the way it was appropriated for and on the programs and projects based on the amount allocated in a given year and for a specific reason such as sustainment, operations, and maintenance of new research and development
- **c.** In the VHA, high-level requirements and architecture artifacts are produced based on a top-down and bottom-up approach
   - **(1)** Business needs are identified, defined, and delivered in support of the VA Strategic Plan and Agency Priority Goals, as well as in response to requests from end users located in a variety of settings throughout the administration, including medical centers
   - **(2)** VHA's business process life cycle leverages requirements and architecture to support investment planning and solution decisions
   - **(3)** The volume and complexity of VHA processes, systems, and business rules drive the need for a disciplined approach to identify, approve, and mature VHA requirements management and development processes
- **d.** There are a number of unique challenges faced by the business analysts and architects that support high-level requirements development in VHA as well as in the DoD
   - **(1)** One is the agencies healthcare mission and the need for the business analysts to work with a geographically

dispersed stakeholder population who employ a diverse number of HIT systems and demand more innovative solutions to improve effectiveness and efficiency of care delivery

e. Requests for changes for enhancements to existing systems are gathered from a variety of sources in both agencies, including staff in the field via a Web portal, but senior executives responsible for Medical Programs also direct requests

(1) For the VA requests for new services can originate in response to business process issues, transformational initiatives, patient safety alerts, national directives, legislative mandates, regulatory guidelines, VA-defined material weakness findings, and system-wide Office of the Inspector General findings

(2) As a result, requirements team members must have skills that allow them to achieve a balance between programmatic direction and strategic plans, and the functional needs of the end users in the field

(3) They must also apply process reengineering skills to recommend policy or training initiatives, instead of HIT enhancements where appropriate

(4) However, these challenges are well balanced against a culture that places a high value on nursing informatics within the practice of healthcare and the development of HIT solutions

f. The DoD and the VA have been engaged for many years with clinical information management activities and consensus building through the Interagency Clinical Informatics Board (ICIB)

(1) The ICIB ensures that clinicians lead the prioritization of recommendations for electronic health data sharing (VA-DoD Interoperability, June 2, 2009)

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- In summary, this chapter provided information on the federal healthcare sector and the development of health informatics within the Department of Defense and the Veterans Administration
- It provided some concrete examples regarding the size and complexity of providing care across the globe from the austere battlefield condition and aboard ships to fully integrated technologically robust brick and mortar facilities
- In addition, it detailed some of the early advances in computerized medical records and networks that make up the integrated health delivery systems that the federal partners utilize and how the federal partners continue to add to the body of knowledge on interoperability and standards while helping to drive the nation to implement the next generation of electronic medical records that meet meaningful use
- The chapter discussed some of the challenges and opportunities in working as an informatics professional in the federal healthcare sector. Some of those challenges are unique because of the diversity of information technology platforms used to capture data and the infrastructure on which it must be transmitted
- Ultimately, it succeeds because despite the challenges, there is an opportunity to make a difference in the ability to provide quality healthcare to all those we all serve

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe the history of nursing informatics in the federal healthcare sector
- Briefly describe the various roles of nursing informaticists in the federal sector
- Articulate how technology supports information sharing and collaboration with emphasis on the unique populations within the federal sector
- Discuss the high risk and high impact informatics challenges facing the federal government

Teaching Tip

Ask the students to define the keywords

- Federal healthcare sector
- Nursing informatics roles and responsibilities
- Informatics technology and challenges in federal government
- Federal nursing informatics
- Military nursing informatics
- Veteran Affairs nursing informatics

CHAPTER REVIEW QUESTIONS

Question 34.1: Department of Defense (DoD) Military Health Services (MHS) is comprised of what three organizations?

a. The Air Force, Army, and Navy
b. The Navy, Marines, and Department of Veterans Affairs
c. The Air Force, the Marines, and the Public Health Service
d. None of the above

Question 34.2: True or False. The Federal Health is a private health segment organization in the United States.

Question 34.3: Early advances in computerized medical records and networks within the federal sector created what type of systems?

a. Early advances in computerized medical records in the federal sector led to integrated health delivery systems that the federal partners utilize and how the federal partners continue to add to the body of knowledge on interoperability and standards

- **b.** Early advances in computerized medical records in the federal sector led to the utilization of all safety requirements for medication administration and management
- **c.** Early advances in computerized medical records in the federal sector led to staffing and certification criteria for nursing informatics
- **d.** None of the above

Question 34.4: One of the challenges to the Federal health sector IT infrastructure is due to which factor?

- **a.** One of the challenges is the volume of information required in IT
- **b.** One of the challenges is the reliability of the data in the federal sector
- **c.** One of the challenges results from the diversity of information technology platforms used to capture data and the infrastructure on which it must be transmitted
- **d.** There are no challenges to the federal health sector IT infrastructure

Question 34.5: The success of the federal health sector IT program has been attributed to what?

- **a.** The success of the federal health sector IT program is attributed to educating nurses in IT
- **b.** The success of the federal health sector IT is attributed to obtaining resources to develop IT
- **c.** The success of the federal health sector IT program has been attributed to providing an opportunity to make a difference in the ability to provide quality healthcare to all those served
- **d.** The success of the federal health sector IT program is attributed to defining the governance structure across many domains

Question 34.6: The complexity of federal health sector IT results from which factors?

- **a.** The numbers of recipients
- **b.** The number of inpatient hospital facilities
- **c.** Providing care across the globe from austere battlefield condition and aboard ships to fully integrated technologically robust brick and mortar facilities
- **d.** The number of surveillance systems that have to be monitored across the globe

Question 34.7: A challenge for the future federal health sector IT will be?

- **a.** To implement the next generation of electronic medical records that meet meaningful use
- **b.** To achieve ISMP safety across all facilities
- **c.** To implement the standardized laboratory systems across all facilities
- **d.** To achieve national quality standards in all facilities

Question 34.8: What are the roles for nursing informatics to serve in within the federal health sector?

- **a.** The roles range from direct patient care to that of the expert Informatics Nurse Specialist (INS), serving in enterprise level leadership
- **b.** The roles range from system designer to system implementer
- **c.** The roles range from standards developer to system implementer
- **d.** There are no roles in the federal health sector or nursing informatics

Question 34.9: What responsibilities does the Informatics Nurse Specialist have in the federal health sector?

- **a.** Advising authority with regards to all HIT-related issues
- **b.** The strategic development of numerous initiatives to include informatics workforce development; HIT acquisition, governance, and budgeting; management of clinical systems
- **c.** Policy and program development; workflow analysis and development
- **d.** All of the above

Question 34.10: What innovation in IT technology did a nurse from the Department of Veterans Affairs facilitate development of?

- **a.** The VISTA system
- **b.** The MyHealthy Vet
- **c.** The ALTA system
- **d.** Bar Code Medication Administration (BCMA)

ANSWERS AND EXPLANATIONS

Question 34.1: (a) Department of Defense (DoD) Military Health Services (MHS) of the Air Force, Army, Navy.

Question 34.2: False. The federal healthcare sector often is referred to as the “public” or “government” segment.

Question 34.3: (a) Early advances in computerized medical records in the federal sector led to integrated health delivery systems that the federal partners utilize and how the federal partners continue to add to the body of knowledge on interoperability and standards.

Question 34.4: (c) One of the challenges results from the diversity of information technology platforms used to capture data and the infrastructure on which it must be transmitted.

Question 34.5: (c) The success of the federal health sector IT program has been attributed to providing an opportunity to make a difference in the ability to provide quality healthcare to all those served.

Question 34.6: (c) Providing care across the globe from austere battlefield condition and aboard ships to fully integrated technologically robust brick and mortar facilities.

Question 34.7: (a) To implement the next generation of electronic medical records that meet meaningful use.

Question 34.8: (a) The roles range from direct patient care to that of the expert Informatics Nurse Specialist (INS), serving in enterprise level leadership.

Question 34.9: (d) All of the above. INS have responsibilities including: advising authority with regards to all HIT-related issues, and many are involved in the strategic development of numerous initiatives to include informatics workforce development; HIT acquisition, governance, and budgeting; management of clinical systems; policy and program development; workflow analysis and development.

Question 34.10: (d) Bar Code Medication Administration (BCMA).

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Consumer/Patient Engagement and eHealth Resources

• OBJECTIVES

1. Describe the concept of patient engagement from patient, health system, and provider perspectives.
2. Discuss several influences of health policy, specifically the HITECH Act and the American Recovery and Reinvestment Act of 2011, on the development of patient engagement strategies within an EHR framework.
3. Describe three characteristics of a learning healthcare organization, and the potential role of patient engagement.
4. List the primary components and functions of patient portals, and how they differ from other eHealth resources.

• KEYWORDS

Consumer engagement
Patient engagement
eHealth
Meaningful use
Patient empowerment
Patient activation
e-Patients
Patient portal
Learning healthcare organizations
Consumer eHealth tools

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What is patient engagement in healthcare? Can you give examples of patient engagement? What is the role of nursing informatics in patient engagement?

For a WIIFM statement, say to the class, "the focus of this chapter is on the complexities of the concept of consumer/patient engagement and the availability of eHealth resources to support that engagement within the context of improving health outcomes." As a nurse, it is important to understand the role of nursing informatics and consumer/patient engagement.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Consumer Engagement and eHealth Resources

1. Introduction
    a. The mission of healthcare clinicians is the improvement and support of the health and healthcare of consumers: patients, families, communities, and populations

    (1) In addition to the scientific and technological foundations of contemporary clinical practice, one of the necessary components of achieving that mission is clinician and consumer use of enabling technologies, which include eHealth resources, meaningful use of electronic health records (EHRs), and other electronic health media
    (2) Recent developments in health policy, widespread availability of mobile electronic tools, and a shift to value-based healthcare have created a renewed interest in "patient engagement" methods and strategies that lead to improvements in individual and population health
    (3) There are both explicit and implicit suggestions in this topic that the current healthcare system is flawed, and at times demonstrates perverse approaches to achieving improved outcomes of care
  b. Nursing and other clinical informaticists, long involved with clinicians in the design, implementation, and adoption of EHRs, are now finding that they are also more directly involved with patient and family access and use of data from EHRs
    (1) One of the ways this is occurring is through the use of secure electronic communication and Web sites, often sponsored by provider organizations
    (2) Commonly known as patient portals, these secure Web sites are changing the way that clinicians and patients/consumers communicate in both anticipated and unanticipated ways
    (3) Both the new methods of communication and availability of data to patients are having a profound effect on clinicians and on patients
    (4) The language used to describe this phenomenon is variable, but is coalescing around the term, patient engagement

Teaching Tip
The focus of this chapter is on the complexities of the concept of consumer/patient engagement and the availability of eHealth resources to support that engagement within the context of improving health outcomes.

US Health Policy Influences

1. Overview
  a. Although healthcare policy is not the subject of this chapter, a brief review of recent policy influences in the United States, including meaningful use of EHRs as a primary driver of patient engagement, provides the context within which the current emphasis on patient engagement is occurring
2. The American Recovery and Reinvestment Act of 2009 and HITECH Act
  a. The American Recovery and Reinvestment Act of 2009 (H.R. 1–111th Congress, 2009) contained within it a provision for major multiyear investments in the US health information technology (HIT) infrastructure: The Health Information Technology and Economic and Clinical Health (HITECH) Act
    (1) Through a combination of significant federal financial investments and extensive criteria specified for measurement in three stages, the HITECH Act has had a profound influence on the implementation and adoption of EHRs by both eligible healthcare providers and eligible hospitals
    (2) By 2013, 80% (>3800) of eligible hospitals had received incentive payments and 50% of 338,000 registered eligible providers received an EHR incentive payment
3. Meaningful use of EHRs
  a. Meaningful use criteria for eligible providers and eligible hospitals are specified as either core measures (must be met) or menu measures, that is, the provider may choose to meet a specified number of measures from a list of choices
    (1) The Meaningful Use program has been specified in three stages
      i. Stage 1, data capture and sharing: 2011–2012
      ii. Stage 2, advanced clinical processes: 2014
      iii. Stage 3, improved outcomes: 2016
    (2) A complete description of the Meaningful Use program, all criteria, and stages is available from the Centers for Medicare & Medicaid
    (3) Meaningful use criteria are framed within five domains and five objectives which are noted in Table 35.1
    (4) The domains and objectives are specified here to emphasize the influence and drivers for both patient engagement and empowerment
    (5) It is not coincidental that there has been intense focus among both providers and hospital organizations on defining patient engagement strategies that would encourage and even ensure that consumers make use of eHealth resources
4. The Affordable Care Act of 2011
  a. The Affordable Care Act of 2011 created accountability for the Secretary of HHS to "establish a national strategy to improve the delivery of healthcare services, patient health outcomes, and population health"
    (1) By March of 2011, the national strategy was communicated in a report to Congress, which established that strategy within the context of three aims, known as the National Quality Strategy
      i. Better Care: Improve the overall quality of care, by making healthcare more patient-centered, reliable, accessible, and safe
      ii. Healthy People/Healthy Communities: Improve the health of the US population by supporting proven interventions to address behavioral, social, and environmental determinants of health in addition to delivering higher-quality care
      iii. Affordable Care: Reduce the cost of quality healthcare for individuals, families, employers, and government
  b. Ten guiding principles were identified to ensure that goals and outcomes were specified for the three aims
    (1) The first of these principles provides a context for healthcare consumer engagement: "Person-centeredness and family engagement, including understanding and valuing patient preferences, will guide all strategies, goals, and improvement efforts"

        (2) This principle is further defined as:
            i. The most successful healthcare experiences are often those in which clinicians, patients, and their families work together to make decisions
            ii. When patients' needs, experiences, perspectives, and preferences are taken into account—and when they get the clear and understandable information and support they need to actively participate in their own care—outcomes and patient satisfaction can improve
            iii. How patients rate their experience is now widely used as a measure of high-quality care, but more can be done to empower individuals and make sure their needs and preferences are taken into account

5. Office of the National Coordinator Strategic Plan 2011–2015
    a. Also in 2011, the Office of the National Coordinator for Health Information Technology (ONC) published its strategic plan for 2011–2015
        (1) The fourth goal of that plan is to "Empower Individuals with Health IT to Improve their Health and the Health Care System"
        (2) The intent of the goal is to: design health IT policies and programs to meet individual needs and expectations; provide individuals with access to their information; help facilitate a strong consumer health IT market; and better integrate individuals' and clinicians' communications through health IT
        (3) The goal statement also includes the caveat that when the public "is empowered with access to its health information through useful tools, it can be a powerful driver in moving toward patient-centered health care"

6. Institute of Medicine Report 2012
    a. In 2012, the Institute of Medicine published a report supporting the concept that healthcare is on a continuous learning pathway to improve care and lower cost
        (1) The authors highlight four recent developments that enable improved care with lowered costs to become a reality
            i. *Vast computational power* that makes analysis of actual patient care possible
            ii. *Connectivity* making communication between and among patients and professionals a reality, as well as continuously available information
            iii. *System and organizational science advances* that support improvement and efficiencies in care within highly complex environments
            iv. *Empowerment of patients* that "unleashes the potential" for partnerships with professionals in the prevention and treatment activities, particularly those that require behavioral change
    b. In these examples from recent healthcare policy, we see the consistent inclusion of consumers empowered and engaged to improve healthcare and health outcomes through the use of information and information tools

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Consumers and Patients

1. Overview
    a. Throughout this chapter, you will see a consistent theme emerge around the concept of "engagement": multiple words are used as synonyms for engagement, but with imprecise definitions; terms that represent different concepts are often used interchangeably; and from both research and strategic perspectives, the field is young
        (1) The title of this chapter is "Consumer Engagement," however you will note that much of the discussion to follow uses the adjective "patient" as opposed to "consumer"
        (2) Because much of the literature uses "patient" to modify engagement and empowerment, that language is retained in the discussion
        (3) However, it is worthwhile to consider the importance of language in conveying meaning, and to at least briefly discuss the subtle and not so subtle differences between the terms "consumer" and "patient" in the context of engagement
        (4) Dr. Paul Keckley, writing in the foreword to the Deloitte 2012 US Health Care Consumer Survey, includes an excellent description contrasting the two terms
        (5) He asserts that the term "patient" denotes a primarily passive and reactive role, versus the term "consumer," which implies a role that is more active, and able to influence the healthcare industry

Teaching Tip

For example, in regard to "level of engagement in decisions about their treatments, patients depend on physicians to make decisions on their behalf in contrast with consumers who depend on physician recommendation augmented by their own research to confirm or corroborate. Similarly, for awareness of treatment options and associated costs, patients have a low level of awareness and depend on physician opinion while consumers have a high level of awareness and depend on information sources from online tools and social media.

        (6) Both patients and consumers have a high level of trust in providers based on personal experience, but consumers add comparison shopping"
    b. As the field of engagement matures within healthcare, the distinctions between the terms patient and consumer will become more precise and useful for measurement and evaluation

Patient-Centered Care, Patient Empowerment, and Consumer/Patient Engagement

1. Patient-centered care
    a. Although the concept of patient-centered care is not new, over the past 10–15 years, the movement to improve quality, effectiveness, and outcomes of healthcare has included a renewed emphasis on patient-centered care
        (1) Primary examples of this are the development of new models of primary care delivery—the patient-centered medical home (PCMH) and accountable care organizations
        (2) Despite this new focus, there are multiple inconsistencies in how the concept is used and reported

    - **(3)** Examples from Hobbs' dimensional analysis of patient-centered care in nursing include a variety of definitions including personalized meal selections, pleasant environments, emotional support, and inclusive decision-making
    - **(4)** It is the concepts of shared decision-making and patient engagement that are consistent links to patient-centered care
    - **(5)** Carman et al. consider patient- and family-centered care as a broad term "conveying a vision for what healthcare should be," which includes concepts of partnership with providers, patients, and families
    - **(6)** Carman et al. reinforce the fact that the terms patient- and family-centered care are also used interchangeably with patient engagement and patient activation
  - **b.** For this chapter discussion, patient-centered care is a broad term encompassing several characteristics and concepts, often including patient engagement, empowerment, and activation

2. Empowerment and engagement—Aligned but distinct concepts
  - **a.** Empowerment has been defined as "the process of increasing the capacity of individuals or groups to make choices and to transform those choices into desired actions and outcomes"
    - **(1)** In the context of health and health informatics, Brennan and Safran describe empowerment as "granting power to a dependent group or enhancing an individual's ability for self-determination"
    - **(2)** Although the terms empowerment and engagement are often used interchangeably, there are distinctive differences as well as potential interactions between the two concepts
    - **(3)** Patients may become engaged on their own behalf, and are therefore empowered as consumers
    - **(4)** On the other hand, there may be an implicit or explicit "granting" of power to patients by healthcare professionals that indicates "we are partners with you (and/or your family/caregivers), in managing your health and illness," which may then engage the patient
    - **(5)** Exploring the definitions and the relationships between these concepts through research is key to informing appropriate and effective strategies for improving care
    - **(6)** As the term "patient engagement" becomes more frequently used to denote healthcare organizational strategies that encourage portal access and involvement of patients in their care, understanding the tactics that effect both empowerment and engagement and their effect on outcomes becomes increasingly important
  - **b.** The empowerment of individuals is a major theme in both professional and lay literature on patient engagement
    - **(1)** The term "e-Patient" has become identified with concepts of empowerment and engagement from a patient perspective
    - **(2)** The term e-Patient was first used in a white paper describing how health consumers used the Internet
    - **(3)** Originally, they defined the "e" as electronic, then the "e" was expanded to include the terms engaged, equipped, enabled, empowered, and later, educated and expert
    - **(4)** The terms were used to describe an increasing number of healthcare consumers who were using the Internet to research healthcare or disease topics either on behalf of themselves or for friends and family
    - **(5)** The feedback from these consumers was that they experienced "better health information and services, and different (but not always better) relationships with their doctors"

3. Consumer/Patient engagement
  - **a.** The potential for patient engagement to change the trajectory of outcomes of care and cost has been a subject of great interest and research focus within the healthcare community
    - **(1)** Patient engagement, referred to as "a blockbuster drug" was a theme for an entire issue of *Health Affairs*, and the framework for an in-depth report on consumer eHealth, contracted for by the ONC in 2012
    - **(2)** Both of these sources of literature provide evidence that although the term "patient engagement" is frequently used, there is not yet a common definition or understanding of the concept
    - **(3)** This is also supported by Gruman et al. who purport that despite our understanding that there is benefit from patient's actively participating in their care, there has not been a systematic identification of the behaviors that—either implicitly or explicitly—define patient engagement
  - **b.** The use of the term "patient engagement" has grown exponentially in recent years
    - **(1)** Coulter, Safran, and Wasson state that in 2000, patient engagement was mentioned about 10 times per year on a Google search, versus a 2010 rate of over 100,000 mentions per year
    - **(2)** Such volume indicates not only high interest, but also the necessity of clearly defining the concept in order to understand the complex relationships between engagement, health outcomes, and healthcare costs
  - **c.** In 2012, the National eHealth Collaborative conducted a survey of consumer engagement with HIT using its 450 member Learning Network
    - **(1)** A response rate of 21% (n=95) yielded results showing a majority ranking consumer engagement as a high priority, however the majority also indicated that the strategies for achieving patient engagement were still being clarified
    - **(2)** The report provides detailed information about the goals, definitions, strategies, and measures of success for achieving patient engagement as perceived by the respondent group
  - **d.** The voice of the patient has also become more active in regard to healthcare engagement and eHealth resources, as reflected in such publications as *Let Patients Help*, *Doctor, Your Patient Will See You Now*, and *e-Patients Live Longer*
    - **(1)** The books are focused on providing information to consumers and providers, particularly on eHealth and communication, for better management and safer healthcare during patient experiences

(2) In *Let Patients Help*, written by a patient and his physician, the authors address both patient and provider aspects of seeking, understanding, and acting on health information within the context of the relationship

(3) Tip sheets are included for "how to be an e-Patient and an empowering provider"

(4) By contrast, Finn writes as a healthcare consumer, using anecdotes, guidelines, and guidance as a method of encouraging patients to become better agents on their own behalf, and thereby improve healthcare outcomes

(5) In addition to describing multiple methods of digital communication pertaining to healthcare, she includes substantive information on both EHRs and personal health records, and describes the benefits to the patient of access to these data sources

e. Simultaneous to the consumer/patient led emphasis on patient engagement, individuals and groups from the provider community have been offering their perspectives and advocacy

(1) Dr. Daniel Sands, co-founder of the Society for Participatory Medicine, and an early adopter of patient engagement strategies offers a provider perspective: "We healthcare professionals undervalue ourselves if we believe our value to be omniscience in our fields. In fact, our skill (beyond procedural expertise) is in knowing how to find and interpret information and to apply it to an individual patient, as well as to serve as a comforter and healer in the Hippocratic sense"

(2) He describes this developing model of care delivery as "participatory medicine"—a relationship-based model of mutual partnership

(3) A contemporary definition of participatory medicine is found on that interdisciplinary Society's Webpage … "a model of cooperative health care that seeks to achieve active involvement by patients, professionals, care givers, and others across the continuum of care on all issues related to an individual's health. Participatory medicine is an ethical approach to care that also holds promise to improve outcomes, reduce medical errors, increase patient satisfaction and improve the cost of care"

(4) In this definition, we see a focus on individual patient and caregiver relationships across the full continuum of care as well as an explicit connection to the policy drivers of improved outcomes and lower costs of care

f. A similar approach to patient engagement is expressed in the preface to a recently edited collection on patient engagement from the provider and healthcare system perspective

(1) In addition to specifying that "patients need to be equipped, enabled, empowered, and engaged, working in partnership with providers to change the system" Oldenburg includes the necessity of patient's having access to their healthcare data, including medical records, as well as health IT tools

4. Patient engagement and patient activation

a. In addition to the widespread use but imprecise definition of the term patient engagement, another term—patient activation—is sometimes used in the same context, and is also not clearly defined

(1) In their review of the evidence about the effect of patient activation on health outcomes, care, and costs, Hibbard and Greene define both terms

(2) They state that the terms engagement and activation are used interchangeably, but without clear definition and with different meaning

(3) Patient activation assumes that a patient understands their role in the care process, and has the "knowledge, skill, and confidence to manage their health and healthcare"

(4) In contrast, patient engagement includes activation, that is, patient engagement may include strategies to encourage or support activation

(5) Both of these terms assume that an individual is capable of acting on their own behalf, rather than simply complying with medical directions

b. Researchers have developed a Patient Activation Measure (PAM) which has been used in multiple studies to demonstrate the relationship between degree of patient activation and degree of participation in preventive behavior, healthy lifestyle, and avoidance of harmful behaviors

Teaching Tip
Table 2 displays summary directional significance for the results of several studies using the PAM to determine health outcomes.

(1) There is some evidence that lower activation scores are also associated with higher costs, and also predictive of higher future costs, however specific utilization patterns have not yet been demonstrated

(2) Despite the sometimes interchangeable use of these imprecisely defined terms, clarity is being developed through the systematic use of a tested measure, and the exploration of relationships to better outcomes and lower costs

Teaching Tip
Refer to Table 3 which provides selected examples of definitions of patient engagement, which emphasizes the current complexities of measuring the effect of patient engagement on health outcomes and costs.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Patient Engagement in the Context of eHealth Resources

1. Overview

a. Two of the characteristics that are consistently associated with patient engagement are communication and access to information

(1) We use the term "eHealth" as a bridge term to describe categories of resources available to patients, families, and healthcare providers.

    (2) Such resources are crucial for a true partnership in care to be successful in improving outcomes of care and potentially decrease healthcare costs

    (3) For purposes of discussion, the eHealth is defined as:

> …an emerging field at the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve healthcare locally, regionally, and worldwide by using information and communication technology

  b. Over time, this concept has been further refined to include the participants in eHealth: healthcare clinicians; patients, families, and caregivers; and consumers managing their health

    (1) Although there are innumerable eHealth resources that are available to consumers and providers, in this review, eHealth resources that have direct links to patient engagement—patient portals and online resources—are discussed

2. Patient portals

  a. A patient portal is an electronic gateway through which patients may access their personal health data and communicate with healthcare providers

    (1) The gateway is a secure online Web site, which is often sponsored by individual providers, groups of providers, health systems, or payers

    (2) While all portals allow secure access to at least some personal health data, such as lab test or imaging results and secure patient-provider messaging, portals may vary in functionality

    (3) Some portals provide a broader menu of available services, such as appointment scheduling and bill payment

    (4) The Web site technology may be provided be an EHR vendor or a third-party vendor

  b. Although patient portals, often standalone applications, have been in use for several years, it has not been until recently that there has been substantial progress in this area

    (1) The specification of Stage 1 meaningful use criteria specifying electronic access to personal health data has provided a major incentive for healthcare systems and/or provider groups to offer electronic access

    (2) Not surprisingly, vendors of certified EHRs are developing "companion" applications that offer patients a secure access to at least portions of the EHR, as well as communication with providers

    (3) Evidence of the effectiveness of patient portals in improving health is insufficient

    (4) In a systematic review of the literature, Goldzweig et al. found that although patient attitudes are positive, there may be cultural or health literacy barriers to effective portal use

    (5) In addition, they caution that the patient portal is a new technology requiring ongoing study for effectiveness and patient satisfaction

3. Meaningful use and patient portals

  a. Meaningful use Stage 2 guidelines specifically promote patient engagement through the use of portal technology required by eligible providers and eligible hospitals to allow patients access to personal health data

    (1) The core requirements that are related to the domain of patient engagement and empowerment objectives are listed for reference

    (2) Patient Engagement Core Measure Requirements for Eligible Providers (EP) Stage 2

- Provide patients the ability to view online, download, and transmit their health information within four business days of the information being available to the EP
- Provide clinical summaries to patients for each office visit
- Use clinically relevant information to identify patients who should receive reminders for preventive/follow-up care and send these patients the reminders, per patient preference
- Use clinically relevant information from Certified EHR Technology to identify patient-specific education resources and provide those resources to the patient

    (3) Patient Engagement Core Measure Requirements for Eligible Hospitals Stage 2

- Provide patients the ability to view online, download, and transmit information about a hospital admission
- Use clinically relevant information from Certified EHR Technology to identify patient-specific education resources and provide those resources to the patient

4. Consumer engagement with eHealth tools

  a. The alignment of meaningful use criteria with increased consumer access to electronic communication and health information resources has created new pressure for the availability of eHealth tools to be on par with other consumer services

    (1) Ahern, Woods, Lightowler, Finley, and Houston predict that consumer behavior in the use of the Internet and wireless technology for healthcare purposes will create a "sea change" in patient engagement

    (2) They also suggest that three conditions need to exist for the achievement of patient oriented meaningful use:

      i. "Patients need to have access to personally relevant health information and services

      ii. Patients will need to believe that there is value in using HIT

      iii. Specific healthcare improvements should be directly attributable to patients' use of HIT"

    (3) Building on this work, Marchibroda and deBronkart conceptualize three types of electronic health tools for engaging consumers: those that support patient education and self-care; those that support patient information and transaction needs associated with care delivery; and those that support care delivery

Teaching Tip

Refer to Table 4 which displays examples of each of the three eHealth tools.

b. These examples provide a very limited high-level view of resource categories

  (1) There are multitudes of online content-rich (and poor) health resources available to consumers and providers alike

  (2) Examples include symptom management, disease management, decision support, health literature, research results, condition and disease guidelines, and resources for caregivers, to name a few

  (3) For an in-depth review of both available consumer health content and methods for determining the quality of that content, please see Zielstorff and Frink

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- As this chapter is concluded, we suggest that this discussion is one point on a trend line
- The status of eHealth resources is continually evolving, as are the roles of consumers, patients, and clinicians in regard to the use of eHealth resources
- As presented here, patient engagement, an inclusive term with several definitions, is considered and named to be a major influence on the ultimate outcomes and cost of care
- However, distinctive similarities and differences between patient-centered care, consumer/patient engagement, patient empowerment, and patient activation are only beginning to be studied and understood
- New technologies, such as the patient portal, have yet to be fully adopted or deployed, and evaluations have been limited. Stage 2 meaningful use is only a few months old. It is a challenging time to be in clinical care and clinical informatics
- There is much to be done in clarifying the interaction between consumer/patient engagement, the use of eHealth resources, and outcomes of care
- There is ample opportunity for contribution:
  - Participate in consumer/provider groups to establish criteria for effective e-communication
  - Explore the possibilities of providing more effective interactive educational content for patient portals
  - Partner with consumers in developing governance structures for managing patient and consumer access to institutional eHealth resources
  - Establish methods for measuring and evaluating consumer, patient and family, and provider satisfaction with the developing process
- It is clear that this is a time of profound change
- Concepts such as patient engagement have been infused with meaning and anticipated results that currently outstrip our ability to measure
- However, the goal is of high value: working in partnership—consumers, patients, and families, and clinician providers—to improve the outcomes of care while contributing to responsible cost reduction

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe the concept of patient engagement from patient, health system, and provider perspectives
- Discuss several influences of health policy, specifically the HITECH Act and the American Recovery and Reinvestment Act of 2011, on the development of patient engagement strategies within an EHR framework
- Describe three characteristics of a learning healthcare organization, and the potential role of patient engagement
- List the primary components and functions of patient portals, and how they differ from other eHealth resources

Teaching Tip
Ask the students to define the keywords

- Consumer engagement
- Patient engagement
- eHealth
- Meaningful use
- Patient empowerment
- Patient activation
- e-Patients
- Patient portal
- Learning healthcare organizations
- Consumer eHealth tools

CHAPTER REVIEW QUESTIONS

Question 35.1: What is the goal of patient engagement?

a. The goal of patient engagement is working in partnership—consumers, patients and families, and clinician providers—to improve the outcomes of care while contributing to responsible cost reduction

b. The goal of patient engagement is improving the efficiency and effectiveness of healthcareThe goal of patient engagement is to encourage the consumer to use mHealth

c. The goal of patient engagement is to encourage the patient and families to utilize more telehealth

Question 35.2: What are two IT driving forces of patient engagement?

- **a.** The regulatory mandates for patient engagement and the consumers need to know
- **b.** New methods of communication and the availability of data to patients
- **c.** New laws in individual states allowing patient access to EHRs and the consumers need to know
- **d.** a and c only

Question 35.3: The first guiding principal of the National Quality Strategy that provides a context for the consumer engagement states:

- **a.** Consumers have a right to their own data, at the right time, in the right place
- **b.** Consumers have the right to access their EHR and medication profiles
- **c.** Person-centeredness and family engagement, including understanding and valuing patient preferences, will guide all strategies, goals, and improvement efforts
- **d.** Person-centeredness should be included in every consumer portal

Question 35.4: Which goal of the ONC Strategic Plan for 2011–2015 includes the concept of patient empowerment?

- **a.** There are no goals in the ONC Strategic Plan for 2011–2015 to include patient empowerment
- **b.** The first goal on establishing the patient portal
- **c.** The fourth goal on Health IT to improve their Health and the Health Care System
- **d.** The tenth goal on establishing tutorials for patients to get credentialed in participating in health IT

Question 35.5: Name two eHealth resources that engage patients.

- **a.** Patient portals and online resources
- **b.** CPOE and patient portals
- **c.** Web-based patient educational resources and CPOE
- **b.** None of the above

Question 35.6: A patient portal is defined as _____________

- **a.** A button that they wear to call emergency personnel in case of falls
- **b.** An access point on all computers that directs patients to valid and reliable healthcare information
- **c.** An electronic gateway through which patients may access their personal health data and communicate with healthcare providers
- **d.** None of the above

Question 35.7: Name three types of data that maybe on a patient portal.

- **a.** Data such as lab test or imaging results and secure patient-provider messaging
- **b.** Data such as their family history, lab results, and their financial retirement plans
- **c.** Data such as their personnel file, economic status, and financial credits bureau information
- **d.** Medication data, how to get to the closest pharmacy, and FDA consumer reports on drug safety

Question 35.8: True or False. A patient portal an also be used for patient appointment scheduling and bill payment.

Question 35.9: What government policy has been an incentive for the patient to have access to a personal health record?

- **a.** The National Quality Plan
- **b.** The FDA Strategic Initiative for Device Utilization
- **c.** The specification of Stage 1 meaningful use criteria specifying electronic access to personal health data has provided a major incentive for healthcare systems and/or provider groups to offer electronic access
- **d.** The IOM Report on Consumer Engagement

Question 35.10: What are three types of eHealth tools for engaging the consumer/patient?

- **a.** Those that support patient education and self-care; those that support patient information and transaction needs associated with care delivery; and those that support care delivery
- **b.** Those that support their participation in self-medication use, those that support their own symptom reporting, and those that support independent care
- **c.** Those that support identifying sources for patient education, those that support symptom management, and those that support exercise and diet recommendations
- **d.** Those that support behavioral change such as diet, exercise, and smoking

ANSWERS AND EXPLANATIONS

Question 35.1: (a) The goal of patient engagement is working in partnership—consumers, patients and families, and clinician providers—to improve the outcomes of care while contributing to responsible cost reduction.

Question 35.2: (b) New methods of communication and the availability of data to patients.

Question 35.3: (c) Person-centeredness and family engagement, including understanding and valuing patient preferences, will guide all strategies, goals, and improvement efforts.

Question 35.4: (c) The fourth goal of that plan is to "Empower Individuals with Health IT to Improve their Health and the Health Care System" (Office of the National Coordinator of Health Information Technology, 2011, p. 5).

Question 35.5: (a) Patient portals and online resources.

Question 35.6: (e) A patient portal is an electronic gateway through which patients may access their personal health data and communicate with healthcare providers.

Question 35.7: (a) Data such as lab test and imaging results and secure patient-provider messaging.

Question 35.8: True. Some portals provide a broader menu of available services, such as appointment scheduling and bill payment.

Question 35.9: (c) The specification of Stage 1 meaningful use criteria specifying electronic access to personal health data has provided a major incentive for healthcare systems and/or provider groups to offer electronic access.

Question 35.10: (a) Those that support patient education and self-care; those that support patient information and transaction needs associated with care delivery; and those that support care delivery (Marchibroda & deBronkart, 2013, pp. 71–73).

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PART 6

Nursing Informatics—Complex Applications

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36

Healthcare Analytics

• OBJECTIVES

1. Define healthcare analytics and related terms.
    i. Data
    ii. Information
    iii. Knowledge
    iv. Wisdom
    v. Decision Support
    vi. Business Intelligence
    vii. Knowledge Management
    viii. Performance Management
    ix. Predictive Analytics
2. Describe the difference between report production and analytical drill down evaluations for decision support.
3. Discuss how decision support, business intelligence, and performance management fit.
4. Illustrate how analytics contributes to and fuels rapid-cycle improvement processes.
5. Discuss data governance for optimal use of analytics.

• KEY WORDS

Value-based purchasing
Triple Aim
Quality Metrics
Population health
Accountable care organizations
Middleware
Enterprise data warehouse
Data validity
Key performance indicators
Transactional processing systems
Management information systems
Data visualization tools
Database administrator

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of how analytics can be used to improve healthcare? How can analytics be used to improve patient safety? Do you look for statistics regarding patient safety for hospital performance, why or why not? Would this influence your choice in selecting a healthcare organization? Do you check for statistics when you go to your doctor, why or why not? Should your doctor or nurse practitioner provided a yearly summary of performance statistics such as how many patients stopped smoking, participated in weight loss programs, or participated in cancer screening? Would this influence your choice of a healthcare professional?

For a WIIFM statement, say to the class, "this chapter deals with what is healthcare analytics. Analytics and business intelligence (BI) can help organizations achieve the triple aim and make care safer. The true beneficiaries of efforts to become an analytics-focused organization are both individual patients and populations of patients." As a nurse, it is important to understand how analytics and BI can be used to improve healthcare.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
    - **a.** Business intelligence, performance management, information technology (IT), and analytics are currently contributing to transformational healthcare reform
        - **(1)** When Don Berwick was chief executive officer (CEO) of the Institute for Healthcare Improvement (IHI), he and his organization coined the term, "The Triple Aim"
        - **(2)** The three components of Triple Aim are
            - **i.** Improve the experience of care
            - **ii.** Improve the health of populations
            - **iii.** Reduce the per capita costs of healthcare
    - **b.** In July, 2010 Berwick was appointed by President Barack Obama to serve as the Administrator of the Centers for Medicare and Medicaid (CMS) through a recess appointment
        - **(1)** He was tapped to implement the Affordable Care Act (ACA), which was enacted in March, 2010
        - **(2)** (It was later defended and supported by the Supreme Court in June, 2013)
        - **(3)** In December 2011 Berwick resigned from CMS
        - **(4)** Although Berwick's time was short at CMS his legacy remained
        - **(5)** He brought with him the concept of the Triple Aim and it stuck
        - **(6)** The Triple Aim concepts continue to be the driver of Governmental healthcare policy and funding
    - **c.** Although the ACA, which was enacted in 2010, occurred three months before Berwick's appointment, the elements of the Triple Aim are highly aligned with the ACA

Healthcare Analytics

1. Overview
    - **a.** This chapter deals with what is healthcare analytics
        - **(1)** Quite simply, analytics is the science of analysis
        - **(2)** Analytics is akin to the central nervous system of the body, where information is processed and is interpreted (analyzed) by the brain
        - **(3)** Analytics is the systematic use of data and related business insights developed through applied analytical disciplines (e.g., statistical, contextual, quantitative, predictive, cognitive, other [including emerging] models) to drive fact-based decision making for planning, management, measurement, and learning. Analytics may be descriptive, predictive, or prescriptive
    - **b.** When applied to healthcare, analytics incorporates business intelligence (BI) information from a variety of systems including
        - **(1)** Electronic health records (EHRs)
        - **(2)** Financial systems (e.g., general ledger and billing systems)
        - **(3)** Stand-alone analytical applications; admission, discharge, and transfer (ADT) systems
        - **(4)** Enterprise resource planning (ERP)
        - **(5)** Time and attendance
        - **(6)** Scheduling systems
        - **(7)** Stand-alone clinical department applications, such as laboratory, radiology, OB/GYN, other electronic systems
    - **c.** Analytic applications are able to apply statistics, formulas, modeling, and is expressed with visual analytical tools such as scorecards and dashboards with drill down capabilities

Teaching Tip

See Table 36.2 as the first step in understanding analytics is to start with a few basic associated definitions.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Analytics in Healthcare

1. Overview
   - **a.** The use of analytics, clinical and BI, performance management, predictive modeling and simulation and the use of enterprise data warehouses (EDWs) in healthcare are not new
     - **(1)** Health insurance plans (also called "payers") have been using EDWs and data marts for 20 years
     - **(2)** While seeming new to healthcare, analytics have been used by hospital chief financial officers (CFOs) for well over 10 years
     - **(3)** The finance department of hospitals is routinely monitoring and tracking a variety of financially oriented scorecards and dashboards
   - **b.** Years ago the payer community realized that having multiple best-of-breed departmental electronic systems, each of which has its own analytical applications for reporting, caused problems when data from different systems needed to be combined and reported together
     - **(1)** Because each proprietary best-of-breed department system has different ways of describing, entering, formatting, storing, handling, and reporting data when multiple diverse systems are compared, it is the equivalent of the "Tower of Babel" with many different languages and no way to normalize or standardize data
     - **(2)** An EDW takes data from multiple source systems, extracts, transforms and loads (ETL) the data into one standardized and normalized format
     - **(3)** Once the data is normalized and standardized it comprises "one version of the truth" (i.e., a reliable and trusted source of data)
     - **(4)** Descriptions of the data, including the data source; formats; descriptions; calculations; etc., are stored in the metadata
     - **(5)** Metadata is data about the data
     - **(6)** The middleware, or presentation layer, enables users to access the data
     - **(7)** Common-off-the-shelf (COTS) query tools are listed below
     - **(8)** In addition, visual application dashboard tools such as Qlickview, Tableau, Spotfire, MicroSoft Visual Stack, etc., can be used for dashboards
     - **(9)** Common "middleware" or reporting/analytics tools used in hospitals are
       - **Crystal reports**
       - **Business Objects**
       - **Excel:** Used for analysis, reporting and manual integration of data
       - **SSRS:** SQL Server Reporting Services is used as a way of extracting and manipulating data
       - **SPSS:** Used for statistical analysis in social science
       - **R:** A free software programing language and software environment for statistical computing and graphics. It is used at many academic medical centers
       - **RDL:** Report Definition Language used for data reporting
       - **Microsoft – Access Database:** Used for storing and manipulating data obtained from other systems
       - **PORG:** Personal Option Report Generator used by some financial and payroll systems for reporting and data extraction
       - **SQL:** Standard Query Language used to run reports and extract data from relational databases
       - **Promodol:** Tool for data simulation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Basic Healthcare Analytics Definitions

1. Overview
   - **a.** Analytics falls under the decision support systems (DSS)
     - **(1)** Often clinicians find this difficult to understand
     - **(2)** They are used to limit their thinking to DSS as being only alerts and reminders that are built into EHRs
     - **(3)** Actually, DSSs are an overarching and all-encompassing term used to describe and computerized system that enables the process of decision making

Teaching Tip
Various types of decision support terms are described in Table 36.3.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Difference Between Reports and Analytics

1. Overview
   - **a.** There are often misconceptions associated with analytics and reports. Both reports and analytics are considered to be forms of business intelligence (BI)
     - **(1)** Remember, any data or information generated from electronic systems is considered to be BI
     - **(2)** Reports or analytics can be for
       - Quality of care, such as how many pressure ulcers have occurred in the hospital, when they occurred, and what was the patient's age, diagnosis, sex, etc. in order to reduce the number of pressure ulcers
       - Service Line analysis, such as for low birth weight babies, what was the age of the mother, ethnic group, the presence or absence of prenatal care, economic status, education, zip code, etc. to set the stage for outreach to populations at risk for low birth weight babies

- Clinical effectiveness, such as evaluating the time taken in a colonoscopy and correlating the total time of the procedure to incidents of missed diagnoses of colon cancer to lower the rate of patients whose colon cancer was missed during a colonoscopy procedure
- Variation in practice (cost, quality, length of stay, and post-operative complications) when comparing bowel resections performed by general surgeons versus gastroenterology specialists to consul and coach physicians with outcomes that consistently deviate from the outcomes of the top performers
- Operational effectiveness, such as evaluating the time from arrival in the emergency department to admission to a patient floor, to reduce patient wait times
- Improve financial performance, such evaluating the number and reasons for claims denials to lower the number of denials

b. The greatest shortcoming of reports is that the ability to analyze them is often limited. That is, frequently, when a single report is studied, additional questions arise, such as

(1) Is this a single incident?

(2) Is it isolated or is it happening elsewhere?

(3) How long has it been occurring?

(4) Is it occurring all the time or is it occurring on a specific day of the week or time of day?

(5) Is it universal or does it pertain to specific providers?

(6) Is it occurring at all locations or specific locations?

(7) Is it seasonal or not?

(8) Has it happened before?

c. To answer these type of questions additional reports may need to be created

d. In contrast, analytics often offers the ability to drill down to the lowest level of granularity

(1) Additionally, with analytics, multiple electronic systems can be incorporated to generate a more detailed understanding of the situation and the ability to uncover a problem that otherwise might not be evident

Teaching Tip

For example, a static report may show that cardiac ventriculograms have increased, while an analytical analysis may show that 60 percent of these studies were not reimbursed by the commercial health insurance payers because these tests were considered medically excessive and unnecessary because an echocardiogram was the recommended test for the diagnosis code listed. (See Table 36.4).

e. Another important element in understanding data and information is the data source and how the reporting applications determine the values used in the reporting functions

(1) Each analytical application has its own vocabulary or metadata (data about the data)

Teaching Tip

For example, one system may calculate length of stay (LOS) as an occupied hospital bed at midnight. Another system may include observation beds in its LOS calculation or calculate at a different time of day. When a variety of systems have different lexicons, obviously the results are different as the numerators and denominators differ.

(2) Physicians, nurses, and other clinical providers often do not understand that variations in how data is captured, organized, stored, and reported depends on how the definitions are structured and that if the same question were asked and reported on by 10 different analytical applications that have different formats the reports would have dissimilar results

(3) The fact that a clinician or executive can ask one question and receive many diverse answers tends to confound clinicians who immediately doubt the veracity and validity of the results. In the world of EDWs, if clinicians doubt that the results are a true reflection of the data they quickly discount the value of the EDW diminishes

(4) Once doubts of the data's veracity are raised the use of the EDW diminishes. It is important that clinical informatics professionals constantly educate the end users as to how reporting and analytics works and how various conflicting reports can be legitimate based on how the data was entered, compiled, the date it was reported, and the exceptions that were extracted before the report was created and how often the data was refreshed

f. It is important to understand the systems where reports originate

(1) That is, is the system is a real-time transactional system or is it an analytical application that has a cut off point for collecting and reporting the data?

(2) Most data warehouses and data marts are not real-time transactional systems

(3) Variation in results reported by different systems (and even in the same system) can occur because of the time the report is run

(4) It is important to understand the type of reporting

Teaching Tip

For example, if an ad hoc report is run at eight o'clock in the morning and the data is refreshed at noon a report run an hour later could differ.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Understanding How Decision Support, BI, and Performance Management Fit:

1. Overview

a. In hospitals and healthcare organizations, there are a variety of systems. It is important to understand these systems and how they are used

(1) The major systems are
  - **Transactional processing systems (TPSs)**—A TPS is used for operational management. They tend to be real-time systems, such as ADT. For example, a transactional system would have minute-to-minute census information. They are used for operations management
  - **Decision Support Systems**—These systems are not transactional, which means that they are not real time. These systems are used for tactical or strategic management decision. Data marts and data warehouses receive data feeds from transactional systems or operational data stores (ODS) at pre-defined intervals. The frequency of data feeds to a data warehouse or a data mart often depends on the decisions that are being made and how current the data needs to be (data latency). For example, a CFO may need to see accounts receivable information daily, while an analytics analysis to calculate financial reserves may only need to be run on a monthly basis. Another example may be a chief quality officer who wants information on the occurrence of hospital acquired conditions (HACs) on a daily dashboard. Business Intelligence systems are a subset of DSS.
  - **Management Information Systems (MIS)**—An MIS consists of transactional data that processes patient data. It includes document management software, health information management systems (HIS), microfiche viewing systems, and telephone systems.
  - **Data Visualization Tools**—Dashboards and scorecards are examples of how data and information can be displayed. It is important to determine the type of dashboard, such as, financial, clinical outcomes, departmental specific, patient flow, service line, etc. When designing dashboards it is important to select the best format

b. The format of the dashboard can be pie charts, graphs, tables, bubble charts, scatter diagrams, run charts (where information is displayed over time), and control charts (similar to run charts with the addition of upper and lower thresholds)

(1) Clinical informatics professionals often need to counsel and discuss with end users, which visual application viewing format would work best

(2) Presenting several prototypes and discussing the advantages and disadvantages of each prototype can be valuable

(3) Some BI experts dislike using pie charts because of the limitations associated

(4) Indeed, the pie chart is the least effective visual analytical display

(5) Vendors of data warehouses, data marts, and analytical applications will have many options for choosing visualization options

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Healthcare Analytics and the Rapid-Cycle Improvement Process

1. Overview

a. Business Performance Management (BPM), also called performance management, focuses more on strategy and objectives

(1) Business Intelligence (BI) is an important element of performance management

(2) Think of BI as the technology and performance management as the additional layer that enables planning, monitoring and analyzing

(3) Using the core BI applications and tools performance management extends the monitoring and measurement for tracking a variety of metrics such as core measures, accountable care organization (ACO) metrics, value-based purchasing (VBP), hospital acquired conditions (HACs), and a long list of other quality and outcomes metrics

(4) Each of the metrics would be described as a key performance indicator (KPI)

Teaching Tip
An example of a KPI would be having 100 percent of vital signs recorded in an EHR.

b. The goal of performance management is to change behavior

(1) Changing behavior and culture is aided by rapid-cycle improvement processes

(2) Rapid-cycle improvement processes are a mechanism to promote rapid behavioral changes leading to cultural changes

(3) The most common rapid-cycle improvement processes used in hospitals today are
  - Plan-Do-Check Act (PDCA)
  - Six Sigma (Define, Measure, Analyze, Improve, and Control)
  - Lean (Voice of the customer, value stream mapping, determination of the value-added and non-value-added steps, create or revise processes)
  - Root Cause Analysis (RCA), (Retrospective analysis of a problem or event—asks a series of why questions to determine the root cause.)
  - Failure Mode Effects Analysis (FMEA), (Process maps current state, identify process failures, estimate effect of identified failures, identify top reasons for failure, and take risk mitigation steps.)

c. Rapid-cycle improvement processes are combined with visual analytical tools, such as dashboards to allow the teams to track progress toward the goals over time

(1) Dashboards are an easy means to determine if the action is working or not and to spark additional questions, which the team can respond to as they work toward achieving the KPIs

Teaching Tip
A use case scenario follows, which integrates the concepts of business intelligence monitoring of performance management to assure that the Meaningful Use Smoking Cessation metric is achieved.

Teaching Tip

Ask the students to work in groups of three to four and analyze the case study. Ask the students to report their findings back to the class.

Use Case Scenario: Performance Management Meaningful Use Smoking Status

There are several steps involved in performance management efforts. This vignette will break down the process into steps. Remember that performance management is essentially a strategic process that is intended to achieve results, produce outcomes, and change behavior. The steps are

- **Strategic planning situation analysis—**To begin our Meaningful Use smoking status performance management project we start by capturing our baseline. At hospital "A," of a multihospital system, smoking status is recorded on 20 percent of the patients. We find that smoking status resides in the EHR under the "social history" category. In order to comply with Stage 1 of meaningful use (MU) the threshold is to have smoking status recorded on 50 percent patients who are 13 years of age or older. The problem with the compliance at hospital "A" is that the nurses are charting smoking status in the wrong cell on their EHR data entry screen. The nurses need to enter it under social history or it will not be captured in the vendor's operational data store (ODS). The EDW is programmed to read and extract this data up from the ODS
- **Planning horizon—**We have one month to the start of the 90-day reporting period. We have to act quickly to resolve the issue of nurses not entering data in the appropriate field to capture that smoking status was evaluated and charted
- **Environmental scan—**Our environmental scan indicates huge variability in hospital compliance. Using our dashboards we see that hospital "A" is at 20 percent and hospital "B" is at 90 percent. This is a strengths, weakness, opportunities, threats (SWOT) analysis. We find huge variability with nurse recording of smoking status and other MU measures. Naturally one asks why the nurses at hospital "A" are at 20 percent compliance while the nurses at hospital "B" are at 90 percent for the very same smoking status recording requirement. Are the nurses at hospital "B" much better nurses? Why the variance? This is where research and observation come into play. Upon investigation it is found that the nurses at hospital "A" are focused on smoking cessation rather than smoking status. These are two different variations of smoking. One is reporting if the patient smokes and the other is focused on an outcome of ceasing the smoking behavior. Smoking cessation is an old requirement that patients receive smoking cessation education. The nurses at hospital "A" provide every patient with smoking cessation education. Since they give all patients (whether they smoke or not) cessation education they believe that it is redundant to record smoking status if they record they have educated the patient on smoking. That is, the nurses felt it is not necessary for them to complete the smoking status information. The environmental scan indicated that education was required to change behavior.
- **Gap Analysis—**Since hospital A's recording of smoking status is at 20% and they need to be over 50% the gap they need to overcome is 30%
- **Strategic vision—**The strategic vision is that all hospitals in the system will have 100 percent compliance with the Meaningful Use thresholds and will, in fact, exceed them
- **Business strategy—**The strategies will be education and compliance monitoring to ensure compliance
- **Identify goals and objectives—**Create an education plan, meet with hospital CNO, hospital clinical informatics professionals, nurse managers, and compliance officers and review each of the MU measures. Inform them of the importance of having nurses enter data appropriately and show where in the EHR product build the data entry cells are located. Explain the monitoring and dashboard systems and explain who will monitor and how often
- **Communication—**The team agreed that education and communication were the key elements. All nurses were needed to be familiar with meaningful use and how where they entered data in the EHR made the difference. The patient care nurses also needed to see and understand the key performance indicators (threshold attained for each MU measure) and the drill down capabilities
- **Rewards and incentives—**It is advantageous when pay and performance are linked. At this multihospital system the executives and the CNO have a business performance scorecard. Achieving the MU thresholds and receiving the CMS EHR incentive funds is tied to their bonuses
- **Focus—**The MU threshold compliance dashboard is viewed at all levels—corporate, region, hospital, compliance office, and individual nursing unit
- **Resources—**Each hospital selects one individual who is ultimately responsible. Most students have experienced situations where a committee is responsible and oftentimes the result is that no one is responsible. At these hospitals the chief operating officer (COO) assumed ultimate responsibility
- **Key Performance Indicators (KPIs)—**The KPIs are the MU 14 Core, 10 Menu, and 15 quality measures. The goal is that the thresholds set by the hospitals, which in most cases exceeds the CMS thresholds, are met. For example, CMS has a 50 percent threshold for smoking status recording while this hospital system established an internal threshold of 80 percent that they expect their hospitals to meet
- **Dashboard—**The hospital system opted for a dashboard to display both the progress bar with red and green to show if they are below (red) or above (green) the CMS threshold. The progress bar allows anyone to view it to see progress toward the goal. The minimum threshold is the line of demarcation between displaying red or green. It also enables users click on one of the measures and see a graphical representation below. The hospital used a control chart as its visual tool. Control charts have upper and lower limits. The upper limit is a line showing the hospital's self-imposed threshold. The lower line of the control chart is the CMS minimum threshold. The control chart also serves as a run chart. You can see that by the end of the reporting period, hospital "A" has achieved 100 percent compliance with the hospitals' standard of 100 percent compliance with recording vital signs

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Applying Analytics in the Workplace

1. Overview
   a. Meaningful use, accountable care organizations, and value-based purchasing (VBP) are areas where healthcare has a need to monitor and measure performance against criteria
      (1) When the CMS Meaningful Use final rules were published by CMS in July 2010 it caused pressure on eligible hospitals and critical access hospitals as well as eligible professionals (EPS)
      (2) It brought with it pressure to have an EHR that would be capable of meeting the 14 Core Measures, 5 of the 10 Menu Measures, and the 15 quality measures
      (3) Eligible hospitals and eligible professionals quickly discovered that they needed computerized support to assist with monitoring and reporting the measures—especially for the 90-day continuous reporting period
   b. Meaningful Use can be seen as a paradigm shift in clinical decision making
      (1) For many years, as decision making was more of an art based on gut reactions, intuition, creativity, judgment, and experience
      (2) This type of decision making was often the best possible option available to executives because the analytical data upon which to make decisions was often lacking or marginal
      (3) Meaningful Use reporting required strict discipline in entering data correctly and reporting and analyzing data
   c. Healthcare organizations have recognized that because of increased complexity in care and the desire to adhere to clinical best practices requires technology
      (1) Knowledge management systems (KMS) support decision making by providing access to knowledge assets and sharing them throughout the organization
      (2) Intellectual assets are also known as intellectual capital
      (3) The use of KMS contribute to high efficiency and foster a culture of collaboration
      (4) KMS include groupware systems, communication tools, collaborate management tools, content management, and document management

Teaching Tip
Ask the students to work in groups of three to four and analyze the case study. Ask the students to report their findings back to the class.

Use Case: Clinical example: Intermountain Health Care's clinical knowledge repository uses validation architecture to ensure documents are valid—Intermountain Healthcare's Clinical Knowledge Repository (CKR) provides a central location to store clinical documents. The CKR contains over 8000 unique documents ranging from Clinical Provider Order Entry (CPOE) order sets to clinical protocols. Most of the content in the CKR is represented in eXtensible Markup Language (XML). The authoring tool used to create CKR XML documents is from a third party XML editor. The authoring tool allows users to create and edit XML documents without requiring them to have knowledge of XML. The XML editor is capable of performing standard XML validations, including verification that the document is well formed and that it is a valid instance of the appropriate XML Schema. In order for the CKR XML documents to operate within their target clinical systems, extensive validation of the content and structure of the XML documents becomes mandatory. A knowledge management validation tool is used. It alerts document authors if they need to fix a document. The result of having the user-friendly error messages is that less than 1 percent of all documents in Intermountain's knowledge repository are invalid.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Analytics and Governance

1. Overview
   a. The failure rate for EDWs is estimated to be as high as 70 to 80 percent
      (1) Failure is due to a variety of issues
      (2) Most importantly the data need to be reliable, well organized and designed with the end users' needs in mind
      (3) Organizations who are embarking on an EDW for the first time usually require expert assistance
      (4) Working with an EDW is iterative
      (5) It is truly a process in which you learn as you progress
      (6) One way to greatly reduce the risk of failure is to use an Agile development approach
      (7) Agile is a rigorous, disciplined approach to systems and software development

Healthcare EDW Readiness Assessment

1. Overview
   a. Before starting a readiness assessment it is important to ensure that the following attributes are in place
      (1) The lack of these items can be red flags that can put a project in jeopardy
      (2) Success factors for an EDW are having
         - Clearly stated mission and vision as well as objectives, such as KPIs. That is, everyone knows and can articulate the need and value of the EDW
         - Highly stable organization with low volatility (turnover) of key leaders. Because a long term commitment to an EDW is paramount to success, if the CEO, CFO, or other senior executive positions are in a state of flux there is greater risk to the EDW project's success. Indeed, when senior leaders change, often the organization's priorities change with them.

An EDW is a major commitment and requires stable, solid, and consistent support over the duration of the project

- Solid, unified and unwavering support, and leadership from the senior executives (i.e., the "C-suite"—CEO, CNO, CFO, CMO, etc.). If there are only occasional pockets of support, the nurse informatics professional is advised to work closely with the C-suite stakeholders to build cohesive support before proceeding. If the organization is prone to "turf wars" where different departments operate in silos and compete with each other for scarce dollars for project funding the risk of failure increases. In this situation the nurse informatics professional may want to create a value-realization chart that identifies how the EDW can benefit each of the various departments. When each department clearly understands and agrees with how the EDW is in their best interest the EDW has a greater chance of a high degree of success
- Strong and reliable source systems such that data integrity issues are minimized. Most data sources have some integrity issues. The IT term, "garbage in, garbage out" (GIGO) refers to introducing messy data sources. When building an EDW if the data integrity of any one of the core systems is questionable the builders will identify the data problems and provide data to assist the upstream system administrators to improve the data quality. Oftentimes data integrity issues are unknown prior to the start of the EDW building process
- Appropriate short- and long-term budget allocation. An EDW is an investment. Once the EDW is established the true value is in the on-going use of the data as it is transformed to information, knowledge, and intelligence to make decisions and change behavior as part of the performance management process. This type of work requires teams and the appropriate funding for staffing teams. If the EDW budget is not protected and allocated over the long term there will be short term gains that may not be able to be sustained
- Appropriately skilled and dedicated staff who are able to remain on the project. When corners are cut on staffing and when important resources are pulled off the EDW project and assigned to other work efforts continuity suffers and can delay the project. Too many missed deadlines and delays contribute to a perception of a troubled project. It is sometimes hard to recover from perceptions that the project is not going well
- Clear communication of the expected functionality at each stage of the project. Setting clear expectations is a critical success factor. Clinicians who have been involved in the role out of an EHR usually understand this principle. It is important to strive for quick wins that impact the strategic or clinical quality priorities. Once success is declared chances are end users see the value and eagerly clamor for additional KPIs that support their specific departments. It is also important to avoid "scope creep." Since EDW projects, by their very nature are iterative, it is wise to build in a buffer to support a small amount of changes. In the governance structure it is advisable to have a change control board (CCB) that can discuss and approve appropriate changes in scope and to deny or protect the integrity of the project such that major changes to the scope are limited
- Cooperative vendors that support the project. The lack of vendor cooperation and using data as a weapon for commercial gain is inappropriate. Oftentimes vendors believe their products or platform can compete or approximate the capabilities and functionality of an EDW. Some of these vendors "hold the data hostage" and deny access to data feeds from source systems. This makes it difficult to obtain the data extracts that feed the data warehouse or the data marts. It may be appropriate to ensure that appropriate legal language is included in contracts that stipulates who is the owner of the data—the vendor or the organization. Uncooperative vendors who impose limitations to data sources, especially an EHR, are essentially coercing, or bullying an organization to purchase their EDW product should not be tolerated
- Strong clinical and technical collaboration approach versus a technical development effort. Weekly reporting of tasks, activities, deliverables, and milestones to the appropriate committees and subcommittees is important. An oversight team of stakeholders needs to attend the weekly team meetings. The project manager and clinical sponsor should be hosting these meetings. An Agile development approach versus a traditional "waterfall" approach to the EDW development—where end users are involved throughout the project contributes to meeting expectations—is more effective

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Business Intelligence and Analytics Data Governance

1. Overview

   a. It is important to have a stakeholder group responsible for overseeing the EDW

      (1) It is advisable to have an analytics competency center (ACC), which is also often referred to as a BI competency center (BICC)

      (2) The role of the ACC is to champion the BI investments, facilitate data standardization, as well as coordinate and oversee all BI activities, ensuring that they are aligned and prioritized in accordance with the overall strategic goals of the organization

      (3) Establishing an ACC is a complex undertaking and before launching one, one must assess both the challenges, including an assessment of the current BI state, as well as the readiness to work as a team in addressing the BI initiatives of the organization

b. There are various approaches to creating an ACC, such as a centralized, consulting, functional, center of excellence, and a decentralized structure

  (1) The various approaches revolve around how the organizations' data analysts are arranged and as well as their reporting structure

  (2) In a centralized model the analysts are combined into one department

  (3) The consulting model also organizes analysts in one unit and the various departments who have analytical requests "contract" with the analyst group

  (4) Functional models situate the analysts in specific departments that routinely use their services, yet in this model consulting services are provided to other departments when required

  (5) Center of excellent models are decentralized and analysts reside in their specific department of expertise, yet have a dotted line arrangement to a program office to respond to requests from various other groups or teams as needed

  (6) The decentralized model places analysts in the departments they are assigned with no connection structure to other analysts

c. Several committees are recommended for an ACC

  - **Executive Oversight Committee**—The executive oversight committee is comprised of senior executive who meet regularly to set strategic analytic direction for the organization
  - **ACC Steering Committee**—The ACC steering committee monitors the EDW development and ensures that the BI and analytics requirements are being met. The steering committee members represent their respective departments and prioritize the KPIs. They evaluate the various electronic and legacy systems to determine which one is to be "the source of truth." That is, often data resides in more than one system. In these situations the committee must decide which system is the one that will feed the EDW. This group also decides on definitions and data lexicons, such as determining a consistent definition on how length of stay is measured and calculated. They also make decisions and document business rules that govern the data as well as logic, data consistency, quality, accuracy, data utilization, and data access. Occasionally disputes can arise because of conflicting priorities. This group works to resolve conflicts and establish a change control process. Another expectation of the committee is to track issues and monitor progress toward resolution. Team members consist of a technical director, an analytics director, analysts, a database administrator, and directors and subject matter experts from across the organization

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- In closing, analytics and BI can help organizations achieve the triple aim and make care safer
- The true beneficiaries of efforts to become an analytics-focused organization are both individual patients and populations of patients

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Define healthcare analytics and related terms:
  - Data
  - Information
  - Knowledge
  - Wisdom
  - Decision Support
  - Business Intelligence
  - Knowledge Management
  - Performance Management
  - Predictive Analytics
- Describe the difference between report production and analytical drill down evaluations for decision support
- Discuss how decision support, business intelligence and performance management fit
- Illustrate how analytics contributes to and fuels rapid-cycle improvement processes
- Discuss data governance for optimal use of analytics

Teaching Tip

Ask the students to define the keywords

- Value-based purchasing
- Triple Aim
- Quality Metrics
- Population health
- Accountable care organizations
- Middleware
- Enterprise data warehouse
- Data validity
- Key performance indicators
- Transactional processing systems
- Management information systems
- Data visualization tools
- Database administrator

CHAPTER REVIEW QUESTIONS

Question 36.1: What is the difference between analytics and reports?

- **a.** Both reports and analytics are considered to be forms of business intelligence (BI) (Remember, any data or information generated from electronic systems is considered to be BI.)
- **b.** The reports are generated from raw data and the analytics have converted the data to visual
- **c.** Reports are nonstandardized and analytics are standardized
- **d.** Reports use common terminology and analytics do not use common terminology

Question 36.2: What comprises the Triple Aim?

- **a.** Quality, costs, and regulatory compliance
- **b.** Use of evidence in improving quality, improve the adoption of regulations, and reduce costs
- **c.** Improve the experience of care, improve the health of populations, and reduce the per capita costs of healthcare
- **d.** All of the above

Question 36.3: How is Analytics Defined?

- **a.** The science of analysis
- **b.** The complex concepts of analyzing data from big data sets
- **c.** The science of nursing, quality, evidence, and health services delivery
- **d.** None of the above

Question 36.4: Which of the following components are included in Business Analytics?

- **a.** Electronic health records (EHRs); financial systems (e.g., general ledger and billing systems)
- **b.** Stand-alone analytical applications; admission, discharge and transfer (ADT) systems
- **c.** Enterprise resource planning (ERP); time and attendance; scheduling systems; stand-alone clinical department applications, such as laboratory, radiology, OB/GYN, other electronic systems
- **d.** All of the above

Question 36.5: True or False? Metadata is data about the data.

Question 36.6: Name three types of Middleware for Business analytics.

- **a.** EHR, Decision Support Tools, and Evidence-based practice guidelines
- **b.** Chrystal Reports, Excel, and SQL
- **c.** Networks, mobile devices, and virtual systems
- **d.** Clinical, financial, and discharge data

Question 36.7: What are two examples of visual tools for Business Analytics?

- **a.** Mobile EHR and MIS.
- **b.** Data from the Department of Radiology.
- **c.** Dashboards and scorecards are examples of visual tools.
- **d.** Output reports from the Quality Department.

Question 36.8: What are common formats for dashboards?

- **a.** Pie chart, graphs
- **b.** Tables, bubble charts, scatter diagrams
- **c.** Run charts (where information is displayed over time), and control charts (similar to run charts with the addition of upper and lower thresholds)
- **d.** All of the above

Question 36.9: True or False. Business Intelligence is an important element of Performance Management.

Question 36.10: What is an ACC?

- **a.** An accountable care center
- **b.** An analytic coordinating consortium
- **c.** An analytics competency center
- **d.** None of the above

ANSWERS AND EXPLANATIONS

Question 36.1: (a) Both reports and analytics are considered to be forms of business intelligence (BI). (Remember, any data or information generated from electronic systems is considered to be BI.).

Question 36.2: (c) According to Berwick, 200, the three components of the Triple Aim are improve the experience of care, improve the health of populations, and reduce the per capita costs of healthcare.

Question 36.3: (a) Quite simply, analytics is the science of analysis.

Question 36.4: (d) All of the above. Business Analytics includes electronic health records (EHRs); financial systems (e.g., general ledger and billing systems); stand-alone analytical applications; admission, discharge and transfer (ADT) systems; enterprise resource planning (ERP); time and attendance; scheduling systems; stand-alone clinical department applications, such as laboratory, radiology, OB/GYN, other electronic systems.

Question 36.5: True. Metadata is data about the data

Question 36.6: (b) Chrystal Reports, Excel, and SQL are three types of common “middleware” or reporting/analytics tools used in hospitals.

Question 36.7: (c) Dashboards and scorecards are examples of visual tools.

Question 36.8: (d) All of the above. Common dashboard formats include: pie charts, graphs, tables, bubble charts, scatter diagrams, run charts (where information is displayed over time), and control charts (similar to run charts with the addition of upper and lower thresholds).

Question 36.9: True. Business Intelligence (BI) is an important element of performance management.

Question 36.10: (c) An analytics competency center.

37

Planning, Design, and Implementation of Information Technology in Complex Healthcare Systems

• OBJECTIVES

1. Define complex systems in the context of General Systems Theory.
2. Describe complex adaptive systems, a special case of complex systems.
3. Illustrate challenges and solutions for planning and designing information technology in complex healthcare systems.
   - i. Wicked problems
   - ii. High-reliability organizations
   - iii. Structured and agile design methods
4. Provide examples of tools and methods used to plan and design information systems in complex healthcare processes.
   - i. Computer-Aided Software Engineering
   - ii. Discrete Event Simulation
   - iii. Network Analysis Tools

• KEY WORDS

Complex adaptive systems
Wicked problems
Agile design
Discrete event simulation
Network science
Nurse informaticist
Electronic Medical Record
Systems analyst

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you provide an example of a system? Can you provide an example of a system in healthcare? Can you provide an example of health information system? Why is it important to understand systems? Why is it important to understand health information systems?

For a WIIFM statement, say to the class, "The objective of this chapter is to provide a review of complex systems from the context of a general systems theory (GST) and then provide an overview of new strategies to plan, design, and implement information systems in healthcare organizations." As a nurse, it is important to understand systems and the implementation of health information systems.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   - **a.** The introduction of information technology into the workflow of clinicians requires thoughtful planning, design, and implementation
     - **(1)** Healthcare organizations of today are among some of the most complex systems in the world
     - **(2)** They are composed of diverse specialties and multiple providers linked through a complex information network
     - **(3)** Understanding and predicting the impact of new technology on healthcare system behavior is an ongoing challenge for nurse informaticists
     - **(4)** That is because complex systems are unpredictable and what works in one organization doesn't guarantee success in another
   - **b.** Nurse informaticists play a critical role in the successful deployment of healthcare information technology
     - **(1)** Their unique blend of clinical knowledge and information systems expertise make them ideal systems analysts
     - **(2)** As complex systems research discovers new findings, nurse informaticists must remain informed on how new knowledge can be translated into practice settings
     - **(3)** The objective of this chapter is to provide a review of complex systems from the context of a GST and then provide an overview of new strategies to plan, design, and implement information systems in healthcare organizations

General Systems Theory

1. **Overview**
   - **a.** A system can be defined as a set of interacting units or elements that form an integrated whole intended to perform some function

Teaching Tip

An example of a system in healthcare might be the organized network of providers (nurses, physicians, and support staff), equipment, and materials necessary to accomplish a specific purpose such as the prevention, diagnosis, and treatment of illness.

     - **(1)** GST provides a general language which ties together various areas in interdisciplinary communication
     - **(2)** It endeavors toward a universal science that joins together multiple fields with common concepts, principles, and properties
     - **(3)** Although healthcare is a discipline in and of itself, it integrates with many other systems from fields as diverse as biology, economics, and the physical sciences
   - **b.** Systems can be closed, isolated, or open
     - **(1)** A closed system can only exchange energy across its borders

Teaching Tip

For example, a greenhouse can exchange heat (energy) but not physical matter with its environment.

     - **(2)** Isolated systems cannot exchange any form of heat, energy, or matter across their borders
     - **(3)** Examples of closed and isolated systems are generally restricted to physical sciences such as physics and chemistry
     - **(4)** An open system is always dependent on its environment for the exchange of matter, energy, and information
     - **(5)** Healthcare systems are considered open and are continuously exchanging information and resources throughout their many integrating subsystems
     - **(6)** Some fundamental properties collectively comprise a GST of open systems
2. **Open systems**
   - **a.** All open systems are goal seeking
     - **(1)** Goals may be as fundamental as survival and reproduction (living systems) to optimizing the flow of information across computer networks
     - **(2)** To achieve goals, systems must transform inputs into outputs
     - **(3)** An input might include the entry of information into a computer where it is transformed into a series of binary digits (outputs)
     - **(4)** These digits can then be routed across networks to end users more efficiently than other forms of communication
     - **(5)** As simple systems interact, they are synthesized into a hierarchy of increasingly complex systems, from subatomic particles to entire civilizations
     - **(6)** Levels within the hierarchy have novel characteristics that apply universally upward to more complex levels, but not downward to simpler levels
     - **(7)** In other words, at lower or less complex levels, systems from different fields share some characteristics in common

Teaching Tip

For example, both computer and biological systems communicate information by encoding it, either through computer programs or via the genome respectively.

     - **(8)** It is the interrelationships and interdependencies between and across levels in hierarchies that create the concept of a holistic system separate and distinct from its individual components
     - **(9)** As commonly noted, a system is greater than simply the sum of its individual parts
3. **Complex systems**
   - **a.** System behavior can be related to the concept of complexity
     - **(1)** As systems transition from simple to complex it is important for nurse informaticists to understand that system behavior also changes

  - **(2)** This is especially important in the management of data and information for clinical and administrative decision-making

Teaching Tip
Table 37.1 presents some examples of differences between simple and complex systems in healthcare.

- **b.** As healthcare systems become increasingly complex it becomes progressively more difficult to predict how changes in provider workflow are impacted by new information technology
  - **(1)** This is especially important for those individuals responsible for planning, designing, and implementing information systems in the healthcare environment of today
- **c.** The evolution of information systems in healthcare is replete with failed implementations, cost overruns, and dissatisfied providers
  - **(1)** It is important to understand, however, that healthcare systems of today are some of the most complex in the world
  - **(2)** The unpredictable nature of complex healthcare systems results from both structural and temporal factors
  - **(3)** The structure of complex systems is composed of numerous elements connected through a rich social network

Teaching Tip
In hospitals, those interactive elements include both internal entities such as patients, nurses, physicians, technicians, and external entities, such as other hospitals, insurance payers, and regulatory agencies.

  - **(4)** The way information flows through this complex web of channels depends on the technology used, organizational design, and the nature of tasks and relationship
- **d.** As systems evolve from simple to complex systems a hierarchy of levels emerges within the organization
  - **(1)** From a theoretical standpoint, complex systems form a “fuzzy,” tiered structure of macro, intermediary, and micro-systems

Teaching Tip
In hospital environments, for example, nursing units can be understood as micro-systems within the health system. When nursing units are combined into divisions (e.g., critical care, medical-surgical, or maternal-child), the nursing units’ internal processes expand beyond their boundaries (e.g., the medication usage process) to create intermediary or meso-systems. Major clinical and administrative systems emerge at the macro level through the aggregation of interactions occurring at lower levels.

- **e.** At the micro-system level, the relationship between cause and effect is somewhat predictable
  - **(1)** However, as the organizational structure expands to include meso- and macro-system levels, causal relationships between stimulus and response become blurred

Teaching Tip
With increasing levels of complexity, the rich network of interactions between nurses, physicians, pharmacists, and other providers at multiple levels within the organization, quickly expands the variability and range of potential states a system might exhibit. This is the driving force behind the unpredictability in complex system behavior.

4. Complex adaptive systems

- **a.** Complex adaptive systems (CAS) are special cases of complex systems; the key difference being that a CAS can learn and adapt over time
  - **(1)** From biologic to man-made systems, CAS are ubiquitous
  - **(2)** The human body, comprised of its many subsystems (cardiovascular, respiratory, neurologic) is a CAS and continuously adapts to short- and long-term changes in the environment
  - **(3)** The same principles can be applied to social organizations such as clinics or hospitals
  - **(4)** Organizational learning is a form of adaptation and it has the capacity to change the culture
  - **(5)** New reporting relationships can alter the structure of a social network and act as the catalyst for adaptation to environmental change

Teaching Tip
For example, the movement from hierarchical organizational structures to quasi-networked reporting relationships can improve communication both vertically and horizontally.

- **b.** CAS exhibit specific characteristics that are different than simple systems and the terminology used to define them may be unfamiliar to healthcare providers

Teaching Tip
Table 37.2 provides a description of the terminology used to describe complex system behavior. Each term in the table builds on the previous term to demonstrate how system behavior becomes unpredictable.

- **c.** As healthcare systems become increasing complex, those individuals challenged with planning, designing, and implementing information technology must be knowledgeable of CAS principles as well as the tools and methods to analyze their behavior

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

It’s All About Flow: Fast and Long, Short and Slow

1. Overview

- **a.** A key concept to understand is that all systems, whether they are natural (rivers, trees, weather) or man-made (stock markets, the Intranet, health systems) have currents that flow through them

  (1) Oxygen and blood flow through animate systems such as trees or humans while water and electricity flow in currents through inanimate systems such as rivers or lightening
  (2) Patients flow through hospitals and clinics while information flows through computer networks and electronic health records
  (3) Without flow, a *system* cannot exist and to survive, it must evolve in a direction that improves its access to designs that improve the flow of currents through them
  (4) In nature, the branching pattern in trees is not accidental
  (5) Rather the configuration of branches is the result of natural selection and the search for optimal designs to transport water and oxygen from the ground back to the atmosphere
  (6) This treelike branching pattern is so efficient it is also seen in other structures such as river basins, the human respiratory system, computer networks, and road systems

b. Just as water flows ***fast*** for ***long*** distances through wide river channels, digitized information flows ***fast*** for ***long*** distances through large cable networks connecting institutions

  (1) As rivers fan out to create deltas, smaller channels form and flow ***slows*** and travels a ***shorter*** distance
  (2) As computer networks branch out to users within organizations, the flow of digital information also ***slow***s and travels ***shorter*** distances as it supplies multiple users
  (3) To optimize and maintain flow, fast and long flow must equal short and slow flow
  (4) In natural systems such as rivers, the ratio of channels that are slow and short make up about 80% of total channels, while the remaining 20% are fast and long
  (5) And this ratio shows up not only in rivers, but in tree branches, the human circulatory system, and computer networks
  (6) Although flow is faster in large river channels than in smaller tributaries, the total flow is maintained by the creation of numerous tributaries that as a whole, are equal to the flow of the larger channels

c. This fundamental concept can also be applied to the flow of electronic data and the design of information systems

  (1) When information is delayed, either as a result of poorly designed systems and cumbersome processes and policies, it is usually a mismatch between "short and slow" and "fast and long" information flow
  (2) If it is overly time-consuming to enter provider orders into an EHR (short and slow) then it delays those orders from being communicated in a timely manner through the health systems computer network to the pharmacy (long and fast)
  (3) As a result, orders stack up (develop queues) and delay the flow of information
  (4) Whenever, delays occur, nurse informaticists should look for imbalances between "short and slow" and "fast and long" information flow

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Information System Planning

1. Overview

  a. The interrelatedness of subsystems characteristic of complex healthcare processes requires participation by many different stakeholders in the planning cycle

    (1) In complex systems, outputs from one process often become inputs to many others
    (2) A new admission on a nursing unit (input) can generate orders (output) to pharmacy, radiology, respiratory care as well as many other departments
    (3) As various levels of care (clinic, hospital, long-term care) become increasingly connected, interoperability of computer systems becomes crucial
    (4) In addition, as clinical and administrative areas become more specialized, it is essential that domain experts participate in the planning process

2. Wicked problems

  a. Problems encountered in complex systems are commonly described as "wicked"

    (1) A wicked problem is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize
    (2) Wicked problem are
      i. Very difficult to define or formulate
      ii. Not described as true or false, but as better or worse
      iii. Have an enumerable or exhaustive set of alternative solutions
      iv. Inaccessible to trial and error; solutions are a "one shot" deal
      v. Unique and often a symptom of another problem

Teaching Tip
Provider order entry (POE) systems often exhibit wicked problem behavior because stakeholders have incomplete, contradictory, and changing requirements. For example, although POE systems have been shown to reduce cycle time for the entire medication management process on a global level, individual providers may spend more time locally, having to enter orders via a keyboard. Here global and local benefits contradict each other. In addition, commercial vendors cannot allow "test driving" their application before purchase (trial and error). Because of the enormous expense associated with the implementation of POE applications, once a system has been installed it is very difficult and costly to remove it (a one shot deal). Finally, because practice patterns vary, each provider wants the system customized to their workflow (each problem is unique). But because there are many providers, there are an innumerable number of alternative solutions.

    (3) Wicked problems cannot be solved by the common rubric of defining the problem, analyzing solutions,

and making a recommendation in sequential steps; the reason being, there is no clear definition of the problem

(4) By engaging all stakeholders in problem solving, those people most affected participate in the planning process and a common, agreed approach can be formulated

(5) Of utmost importance is understanding that different problem solutions require different approaches

Teaching Tip

For example, bar-coded medication management is one strategy for reducing medication errors. However, to be effective, this strategy must be implemented as part of an overall strategy for reducing medical errors. This strategy might be adopting concepts and principles from high-reliability organizations (HROs). An HRO assumes that accidents (or errors) will occur if multiple failures interact within tightly coupled, complex systems. Much of the research regarding HRO has been fueled by well-known catastrophes such as the Three Mile Island nuclear incident, the space shuttle Challenger explosion, and the Cuban Missile Crisis.

3. High-reliability organizations

a. Key attributes of HROs include a flexible organizational structure, an emphasis on reliability rather than efficiency, aligning rewards with appropriate behavior, a perception that risk is always present, sensemaking (an understanding of what is happening around you), heedfulness (an mutual understanding of roles), redundancy (insuring there is sufficient flex in the system), mitigating decisions (decision-making that migrates to experts), and formal rules and procedures that are explicit

(1) Employing information technology, such as bar-coded medication administration, must be implemented in the context of an overall strategy to become an HRO

(2) For example, BCMA emphasizes reliability over efficiency and integrates formal rules and procedures into the medication management process

(3) Collectively, these features reduce the probability of multiple failures converging simultaneously

b. On the other hand, planning for clinical decision support (CDS) applications may require a different approach than implementation of BCMA

(1) CDS systems link health observations with health knowledge to influence health choices by clinicians for improved healthcare

(2) These applications cover a broad range of systems from simple allergy alerts to sophisticated algorithms for diagnosing disease conditions

(3) The cognitive sciences inform and shape the design, development, and assessment of information systems and CDS technology

(4) The subfield of medical cognition focuses on understanding the knowledge structures and mental processes of clinicians during such activities as decision-making and problem solving

c. Optimizing the capabilities of CDS systems to allow better decision-making requires an understanding of the structural and processing patterns in human information processing

(1) For example, knowledge can be described as conceptual or procedural

(2) Conceptual knowledge refers to a clinician's understanding of specific concepts within a domain while procedural knowledge is the "how to" of an activity

(3) Conceptual knowledge is learned through mindful engagement while procedural knowledge is developed through deliberate practice

(4) If CDS planners are not careful, they may inadvertently design a system that transforms a routine task such as checking a lab value (procedural knowledge) into a cumbersome series of computer entries

(5) If the clinician is simultaneously processing conceptual knowledge (problem solving and decision-making) and complex procedural tasks, it will place an unnecessary burden on working memory and create frustration

d. In summary, the frequent occurrence of wicked problems in complex healthcare systems highlights the challenges faced by information system planners today

(1) Successful planning for the introduction of information technology requires participation by a diverse group of stakeholders and experts

(2) There is no "cookie cutter" solution in system planning

(3) Each application must be aligned with an overall organizational strategy which drives the implementation approach

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Information System Design

1. Overview

a. The characteristic behavior of complex systems and the emergence of wicked problems have prompted system planners to search for new methods of system design and implementation

(1) The introduction of new information technology in healthcare organizations involves the integration of both new applications and incumbent legacy systems

Teaching Tip

For example, a new POE application will need to interface with existing pharmacy, radiology, and lab systems. Although, an initial "starter set of orders" usually accompanies the POE application, the task of interfacing it with appropriate departmental systems, creating new order sets, and developing CDS generally falls to an internal implementation team with vendor support. Over time, this development team will design and build a POE system that is much different than the original application.

2. Structured design

a. Historically, design and implementation of healthcare information systems relied heavily on structured methods

(1) The most common structured design and implementation method used is the System Design Life Cycle (SDLC)

  - **(2)** The SDLC acts as a framework for both software development, implementation, and testing of the system

Teaching Tip
Table 37.3 presents the broad steps in the SDLC.

- **b.** An SDLC approach prescribes the entire design, testing, and implementation of new software applications as one project with multiple subprojects
  - **(1)** Project deadlines can extend over many months and in some cases years
  - **(2)** The method encourages the use of standardization (e.g., programming tools, software languages, data dictionaries, data flow diagrams, and so forth)
  - **(3)** Extensive data gathering (interviews, questionnaires, observations, flowcharting) occurs before the start of the project in an effort to predict overall system behavior, after full implementation of the application

3. Agile design

- **a.** As healthcare systems have become increasingly complex, the SDLC approach has come under fire as being overly rigid
  - **(1)** Behavior, characteristic of complex systems (sensitivity to initial conditions, nonlinearity, and wicked problems), is often unpredictable, especially after the introduction of information technology in clinical workflow
  - **(2)** Equally challenging is the difficulty of trialing the impact of new information systems before having to actually purchase them
  - **(3)** Site visits to observe a successful application in one facility are no guarantee of success in another
  - **(4)** Many healthcare organizations have spent countless millions in failed system implementations
- **b.** To overcome these problems, healthcare organizations are turning to "agile" methods for design and implementation of information systems
  - **(1)** Agile design is less prescriptive than structured methods and allows for frequent trial and error
  - **(2)** Rather than mapping the entire project plan up front, agile methods clearly define future milestones, but focus on short-term successes
  - **(3)** To do so the implementation team and software developers collaboratively evaluate and prioritize the sequence of task to implement first
  - **(4)** Priority is assigned to tasks that can be accomplished within a short time frame, with a minimum of cost while maintaining high-quality standards
  - **(5)** This "timeboxing" of projects forces the team to search for simple, but elegant solutions
  - **(6)** Developers often work in pairs to cross check each other's work and distribute the workload
  - **(7)** Communication is free flowing between developers and the implementation team
  - **(8)** Once a solution is developed it is rapidly tested in the field and then continuously modified and improved
  - **(9)** There is a philosophy that the interval between testing and feedback be as close as possible to sustain momentum in the project
- **c.** Agile design is one example of how to manage information technology projects in complex systems
  - **(1)** Rather than trying to progress along a rigid project schedule, simple elegant solutions are rapidly designed, coded, and tested on a continuous basis
  - **(2)** Over time, layer upon layer of elegant solutions evolve into a highly integrated, complex information system
  - **(3)** Ironically, this is the same process that many natural systems have used to evolve into their current state

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Systems Analyst Toolbox

1. Overview

- **a.** Whether structured or agile design methods are used during project implementation, systems analysts rely heavily on various forms of modeling software
  - **(1)** Modeling applications visually display the interaction and flow of entities (patients, providers, information) before and after implementation of information technology
  - **(2)** Models link data dictionaries with clinical and administrative workflow through logical and physical data flow diagrams
  - **(3)** Models can be connected through a hierarchy of parent and child diagrams to analyze system behavior locally (at the user level) and globally (management reports). There are many commercial modeling tools available

Teaching Tip
Table 37.4 presents various types of modeling software and how they are used.

2. Discrete event simulation

- **a.** Two software applications that are well suited for the analysis of complex systems are discrete event simulation (DSA) and network analysis (NA)
  - **(1)** DSA is a software application that allows analysts to flowchart processes on a computer and then simulate entities (people, patients, information) as they move through individual steps
  - **(2)** Simulation allows the analyst to quickly communicate the flow of entities within a process and compare differences in workflow after the introduction of new technology
  - **(3)** DSA applications contain statistical packages that allow analysts to fit empirical data (process times, inter-arrival rates) to theoretical probability distributions to create life like models of real systems
  - **(4)** Pre- and post-implementation models can be compared for differences in cycle time, queuing, resource consumption, cost, and complexity
  - **(5)** DSA is ideal for agile design projects because processes can be quickly modeled and analyzed prior to testing

    - **(6)** Unanticipated bottlenecks, design problems, and bugs can be solved ahead of time to expedite the agile design process

3. Network analysis

- **a.** NA applications plot the pattern of relationships that exist between entities and the information that flows between them
    - **(1)** Entities are represented as network nodes and can identify people or things (computers on nursing units, handheld devices, servers)
    - **(2)** The information that flows between nodes is represented as a tie and the resulting network pattern can provide analysts with insights on how data, information, and knowledge move throughout the organization
    - **(3)** NA tools measure information centrality, density, speed, and connectedness and can provide an overall method for measuring the accessibility of information to providers
    - **(4)** NA graphs can uncover power laws in the distribution of hubs in the organization's network of computers and servers

Teaching Tip
See Table 37.2.

    - **(5)** This can be beneficial in investigating the robustness of the computer network in the event a key hub crashes

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Organizational Fragility

1. Overview

- **a.** The potential impact of growing healthcare complexity is enormous
    - **(1)** Beyond a certain level, organizational complexity can decrease both the quality and financial performance of a health system
    - **(2)** In his book, "Antifragile," Taleb describes the concept of fragility in complex systems such as healthcare
    - **(3)** As certain systems become increasingly complex, unexpected events can create an exponentially negative impact

Teaching Tip
For example, the death of a patient, as the result of a medication error propagating across multiple interdependent hospital departments, has a much greater impact on a large hospital than on a smaller one. It takes significantly more resources to investigate and make changes in larger hospitals than smaller ones because of the number of people, departments, types of equipment, and so forth that are involved. Thus increasing size (or complexity) promotes "fragile" behavior in health systems: they break easily.

- **b.** One can get a sense of the impact of size and complexity on the fragility of organizations by scanning the Centers for Medicare and Medicaid's Hospitals Consumer Assessment of Healthcare Providers (HCAHPS) survey scores (HCAHPS Online)
    - **(1)** The HCAHPS provide a standardized survey instrument and data collection methodology for measuring patients' perspectives on hospital care
    - **(2)** The HCAHPS is administered to a random sample of patients continuously throughout the year in hospitals
    - **(3)** From "Communication with Nurses" to "Pain Management," of the 10 hospital characteristics publicly reported, scores decrease with an increase in hospital bed size in nearly every category
    - **(4)** Just as an elephant falling 5 ft suffers significantly more damage than a mouse, large, complex organizations suffer exponentially greater harm than smaller ones for similar events
- **c.** In contrast, certain systems are "anti-fragile" to negative events and actually become stronger as they are stressed

Teaching Tip
A good example, among many, is the human body's immune system, which creates new antibodies when it is exposed to antigens. The concepts illustrated from these biologic "learning systems" can be translated into man-made systems through continuous learning organizations. By learning from stressors (unanticipated events) and then implementing and revising policies and procedures to prevent them from occurring again the health system actually becomes stronger. To illustrate one example of the concept of fragility the following actual use case is described.

Teaching Tip
Ask the students to work in teams of three to four students to discuss the case study. Ask the students to report their findings back to the class.

Designing Systems within an Increasing Complex World—A Case Scenario

In 2005 a large health system located in the Southwest initiated a plan to implement a single vendor, enterprise-wide EHR across its 10 hospitals. The system contained one large academic medical center of 800 beds and 9 hospitals ranging in size from 25 to 475 beds. These hospitals were distributed throughout the state where 50% were in large urban areas and the remainder in rural locations. Although the network of hospitals acted as an integrated delivery system, each implemented their EHR according to their own process and timeline. Thus the success of various EHR implementation strategies used by each hospital could be assessed by measuring specific performance outcomes post-implementation (see Table 37.5).

Complete implementation of the EHR occurred over a three-year period with one hospital at a time going "live" according to a master schedule. One year post-implementation each hospital then compared pre- and post-performance metrics to assess how well strategic objectives were met.

TABLE 37.5 EHR Performance Measures

- User satisfaction (survey tool)
- Staffing utilization and overtime (staffing reports)
- Percent utilization of EHR by providers (management reports)
- Provider productivity (patient visits per day)
- Pharmacy to provider call-backs (pharmacy system reports)
- Number and severity of medication errors (risk management reports)
- Evaluation of documentation quality—legibility, completeness, appropriateness
- Compliance with clinical decision support reminders and alerts
- Volume of lab or imaging procedures ordered (lab and radiology system reports)
- Chart pulls (medical record departmental reports)
- Release of information (ROI) response time and backlog
- Billing turnaround times (revenue cycle reports)
- Claim rejections
- CPT E&M code levels
- Documentation of services (CPT codes)
- Patient satisfaction

Result of the one year post study varied considerably between hospitals and it is beyond the scope of this chapter to review all of the results. However, it is important to note that one hospital significantly outperformed the remaining nine hospitals on nearly all performance metrics. This high performing, community hospital had a bed size of 475 and utilized an "agile" design strategy as compared to the other hospitals that followed a more traditional systems development lifecycle (SDLC).

As previously described, traditional EHR implementation strategies have followed the SDLC (see Table 37.3) using a structured design process. The SDLC typically maps out the complete planning, design, and implementation of projects in advance. This prescriptive process attempts to anticipate all possible future scenarios and then designs and build the system to accommodate them. Nursing, pharmacy, radiology, and other clinical areas then work with commercial vendors to create flowcharts that describe their existing workflows and revise them to align with the EHRs' new workflow.

There are a number of disadvantages of the SDLC that can lead to an increase in organizational fragility in complex systems such as healthcare. These include:

- It is virtually impossible to anticipate all of the different scenarios that may arise in advance
- User needs and technology may change during the implementation phase, especially if the timeline is delayed
- Workflows are often designed in silos (nursing, pharmacy, radiology) and do not communicate well when integrated in an overall workflow

Of the nine hospitals that used the SDLC many of these issues emerged during the implementation of the EHR. For example, because of its size and complexity, the 800-bed medical center had a protracted EHR implementation that spanned three years. Because the entire system was fully designed in advance, it was difficult to accommodate changes in technology and new service requirements that occurred during the three-year implementation. The system could not readily adapt to the emergence of wireless mobile devices (tablets, phones, and so forth), consumer informatics (patient portals), and Web-based services. Although clinical documentation was now electronically stored it was not standardized in a way that accommodated reporting requirements for the Accountable Care Act and "meaningful use." And because workflow design had been developed through individual departments (nursing, radiology, pharmacy, and so forth) communication was slow and cumbersome. Provider order entry systems, clinical documentation, and medication administration all took longer than previous paper systems.

The aforementioned use case is an example of a fragile organizational design. When the system was stressed, such as in a sudden increase in admissions, it quickly became overwhelmed and "broke." Medical errors, system downtime, resources, and cost all exponentially increased rather than decreased in response to unanticipated events.

In contrast to other hospitals, the high-performing hospital utilized an agile design process when implementing their EHR. One team of clinicians, vendor consultants, administrators, and hospital programmers developed a project timeline that "loosely" guided the system over a one-year period. This allowed flexibility for unanticipated events that occurred along the way and did not tie the team down to a ridged plan. Rather than implementing the EHR on all units simultaneously, the same team went from unit to unit and designed the system along the way.

The team designed the system in a modular format rather than building the entire system in advance. The modular format allowed system designers to break workflow up into natural use cases. For example, one nursing module might be "New Patient Assessment" while another might be "Patient Discharge." By using the modular format, designers could make changes to one part of the EHR without having to go back and make multiple changes to other areas.

As the design team went from one department to the next it used a rapid design and implementation strategy. The team would meet with key departmental content experts, review the existing workflow, and then quickly design a new workflow. The new workflow would be rapidly piloted on the unit over a one- to two-week period while continuously making changes based on feedback. This process allowed the team to build upon the success of previous units and make recommendations on best practices. In other words the team was continuously learning from their mistakes and correcting them as they advanced through the organization.

The agile design process used by this hospital is an example of an "anti-fragile" organization. Stressors or unanticipated events actually strengthened the system as the design evolved. That is because an organization that uses feedback to continuously learn, just as in biologic systems, adapts more readily to change and becomes stronger. In high-performing organizations, the design phase never actually ends. It is continuous and always adapting and learning from unanticipated events.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY AND CONCLUSIONS

- Healthcare complexity is growing at an exponential rate
- This, in part, is because new technology, itself is composed of combinations of existing technologies
- For example, POE systems interface with existing applications (technologies) in pharmacy, lab, and radiology

- Each individual departmental application is composed of further subcomponents that are themselves technologies
- This recursive process continues until it reaches the most basic parts of the system
- If each component of this hierarchical tree is considered a technology, then new, novel technologies form from new combinations
- For example, voice activated clinical documentation recently emerged by combining Voice over Intranet (VoIP) technology from other industries with existing EHR systems
- Thus, as we see new technologies grow at a linear rate, the potential combinations of them grows exponentially
- The more potential combinations of technologies there are (combinatorial complexity), the higher the probability of discovering new uses for them
- Thus, technology actually creates itself out of itself
- The relentless march of technology creates both benefits and challenges for nurse informaticists
- As the sheer number of technologies grows, the combinations of them become ever more complex
- Simply look at the complexity of EHR systems in hospitals today. These systems are a mixture of new and legacy systems connected through a complex network of customized interfaces
- Equally complex is the acceleration in how quickly the underlying processes these technologies execute changes
- New knowledge supporting evidence-based practices is growing so fast that new CDS algorithms programmed into today's EHRs can become outdated in a matter of weeks
- Nurse informaticists play a vital role in the successful planning, design, and implementation of information technology
- However to achieve that success, nurse informatics must have an in-depth knowledge of complex systems and strategies to manage its behavior

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Define complex systems in the context of General Systems Theory.
- Describe complex adaptive systems, a special case of complex systems.
- Illustrate challenges and solutions for planning and designing information technology in complex healthcare systems.
  i. Wicked problems
  ii. High-reliability organizations
  iii. Structured and agile design methods
- Provide examples of tools and methods used to plan and design information systems in complex healthcare processes.
  i. Computer-Aided Software Engineering
  ii. Discrete Event Simulation
  iii. Network Analysis Tools

Teaching Tip

Ask the students to define the keywords

- Complex adaptive systems
- Wicked problems
- Agile design
- Discrete event simulation
- Network science
- Nurse informaticist
- Electronic Medical Record
- Systems analyst

CHAPTER REVIEW QUESTIONS

Question 37.1: Complex adaptive systems are defined as _____________

a. Systems that can learn and adapt over time
b. They are complex clinical trials that adapt to the patient over time
c. They are complex systems build with agile methods
d. None of the above

Question 37.2: True or False. In a complex system, all of the inputs and outputs are related to each other.

Question 37.3: A wicked problem comprises all of the features except _____________

a. Very difficult to define or formulate
b. Have an enumerable or exhaustive set of alternative solutions
c. Very accessible to trial and error
d. Unique and often a symptom of another problem

Question 37.4: What component facilitates the connectivity between complex components of systems?

a. Interoperability of computer systems becomes crucial
b. The ability to connect systems with common data elements
c. The ability to extract data from each component of the system
d. None of the above

Question 37.5: A unique characteristic of complex adaptive systems is _____________

a. They have a large number of alternative states
b. The systems behavior becomes more complex over time
c. A large stimulus may have little impact on the outcomes, but a small stimulus may have a large impact on the outcomes
d. All of the above

Question 37.6: A high-reliability organization (HRO) has all of the attributes except _____________

a. A flexible organizational structure
b. An emphasis on reliability rather than efficiency
c. Aligning rewards with appropriate behavior
d. Established workflow for all procedures and processes

Question 37.7: True or False. Agile design methods allow more flexibility in the System Design Life Cycle.

Question 37.8: True or False. Agile designs are focused on long-term successes.

Question 37.9: What are three kinds of modeling software?

- **a.** Flowcharts
- **b.** Computer-aided software engineering tools
- **c.** Discrete event simulation
- **d.** All of the above

Question 37.10: The unit of measure in network analysis tools can be described as ____________

- **a.** The pattern of the relationship often depicted between nodes and ties
- **b.** The use case scenario describing actors and roles
- **c.** Mathematical formulas to show how model inputs change as a process evolves over time
- **d.** Rectangles that may represent processes and diamond that may represent decision points

ANSWERS AND EXPLANATIONS

Question 37.1 (a) Complex adaptive systems are systems that can learn and adapt over time.

Question 37.2: False. In complex systems, outputs from one process often become inputs to many others.

Question 37.3: (c) Wicked problems are not accessible, but inaccessible to trial and error.

Question 37.4: (a) Interoperability of computer systems becomes crucial.

Question 37.5: (d) Complex adaptive systems have many characteristics including they have a large number of alternative state, the systems behavior becomes more complex over time, and a large stimulus may be little impact on the outcomes, but a small stimulus may have a large impact on the outcomes.

Question 37.6: (d) Key attributes of HROs include a flexible organizational structure, an emphasis on reliability rather than efficiency, aligning rewards with appropriate behavior, a perception that risk is always present, sense making (an understanding of what is happening around you), heedfulness (an mutual understanding of roles), redundancy (insuring there is sufficient flex in the system), mitigating decisions (decision-making that migrates to experts), and formal rules and procedures that are explicit.

Question 37.7: True. Agile design is less prescriptive than structured methods and allows for frequent trial and error.

Question 37.8: False. Rather than mapping the entire project plan up front, agile methods clearly define future milestones but focus on short-term successes.

Question 37.9: (d) All of the above. Modeling software includes flowcharts, computer-aided software engineering tools, and discrete event simulation.

Question 37.10: (a) The pattern of the relationship often depicted between nodes and ties.

38

The Quality Spectrum in Informatics

• OBJECTIVES

1. Describe what a quality measure is, the different types of measures, and the data from which they can be derived.
2. Discuss why it is important to measure the quality of care, who has historically been involved in measurement development, and the different uses of measures.
3. Describe the major government and other standards initiatives in quality measurement data infrastructure.
4. Discuss the role of standard terminologies in quality measurement.
5. Describe how clinical quality measures support Meaningful Use of electronic health records (EHRs) and quality management.
6. Describe the development of an eMeasure, its format, and its potential uses for quality improvement and nursing care.

• KEY WORDS

Quality management
Electronic clinical quality measures
Meaningful Use (MU)
Performance measurement
Performance improvement
Clinical decision support
Quality reporting
Electronic health records
Structured terminology
Standards organizations
Nursing quality reporting

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What is quality? What are attributes of quality? Why is quality important in healthcare? How is quality measured? Should healthcare organizations be concerned about quality?

For a WIIFM statement, say to the class, “In this chapter the role of informatics in defining, measuring, and improving care quality will be described. The essential elements of quality measurement will be explored, including explaining the components of a quality measure, the different types of quality measures, the data from which they can be derived, why it is important to measure the quality of care, and for what uses. This will be followed with an overview of the major government initiatives and reporting programs in quality measurement, including the data infrastructure required to ensure success in these programs. The chapter will conclude with an explanation of the life cycle of electronic quality measurement.” As a nurse, it is important to understand quality measurement and the role of health information technology.

CLASS PREPARATION

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   - **a.** In this chapter the role of informatics in defining, measuring, and improving care quality will be described
     - **(1)** The essential elements of quality measurement will be explored, including explaining the components of a quality measure, the different types of quality measures, the data from which they can be derived, why it is important to measure the quality of care, and for what uses
     - **(2)** This will be followed with an overview of the major government initiatives and reporting programs in quality measurement, including the data infrastructure required to ensure success in these programs
     - **(3)** The chapter will conclude with an explanation of the life cycle of electronic quality measurement
   - **b.** In the last decade, there has been a move toward capturing quality measurement information real-time as patient care is provided, and subsequently aggregating and reporting the data to support longitudinal measurement
     - **(1)** To achieve this goal, quality reporting has evolved from paper medical record chart abstraction to electronic quality reporting using the electronic health record (EHR)

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Drivers of Quality Measurement Using Informatics

1. Overview
   - **a.** The Medicare and Medicaid EHR Incentive Programs provide financial incentives for continuously measuring and reporting of clinical quality measures (CQMs) to help ensure that the healthcare delivery system can deliver effective, safe, efficient, patient-centered, equitable, and timely care
     - **(1)** Financial incentives are based on Meaningful Use of EHRs
     - **(2)** This is guided by the National Quality Strategy (NQS), adopted by the Department of Health and Human Services (DHHS), focused on three aims of better care and better health, at lower costs
     - **(3)** Achieving the NQS requires a national infrastructure for electronic quality measurement
   - **b.** Electronic CQMs use a wide variety of data gathered as a byproduct of patient care delivery
     - **(1)** When data necessary for quality measurement are captured as a byproduct of care delivery, and when those data are easily shared between health information technology (IT) systems, care can be better coordinated, and is safer, more efficient, and of higher quality
   - **c.** Ideally, the nation will achieve the NQS by taking full advantage of the EHR to capture high-quality clinical data for quality reporting and performance improvement

Teaching Tip
For instance, using a diagnosis from an EHR problem list captured during care is a more valid source for quality measurement than administrative claims.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Quality Measurement

1. Overview
   - **a.** The quality of care provided in healthcare is often defined as “the degree to which healthcare services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge”
     - **(1)** One of the best ways to determine whether the care provided was effective in improving the desired health outcomes in an evidence-based manner is through measuring or quantifying the performance of an individual or organization
     - **(2)** Performance measurement in healthcare is not a new concept as many organizations have been developing and using measures to assess the quality of care for several decades
     - **(3)** In recent years, the focus has evolved from improving the quality of care at the local level to determining and paying for the care provided based on the level of quality and cost
     - **(4)** This evolution has led to increased rigor in the development and specification of performance measures and leveraging data that is collected at the point of care
     - **(5)** These data can be aggregated easily, making the use of electronic data the obvious option
   - **b.** Performance of the healthcare provider or institution is analyzed through the following constructs or types: structure, process, and outcomes
     - **(1)** These constructs serve as a methodology by which clinical care can be examined to show where gaps in care may be
     - **(2)** **Structure** is defined as “the relatively stable characteristics of the providers of care, of the tools and resources they have at their disposal, and of the physical and organizational setting in which they work”
       - **i.** Structural measures include nurse staffing ratios, the existence of systems such as the use of a registry, and other aspects that would be considered necessary components to ensure appropriate and high-quality care is delivered

(3) **Process** is "a set of activities that go on within and between practitioners and patients"
   i. These measures assess whether an action or step that is needed for patient care is provided
   ii. They are reliant on evidence-based guidelines or research and most often show what percentage of the time a provider or institution is compliant with an assessment or intervention

(4) **Outcomes** are "changes in a patient's current and future health status that can be attributed to antecedent healthcare"
   i. Outcome measures are focused on the success or lack thereof to improving a patient's health status
   ii. These may either be short-term (typically within the 12 months or less) or long-term
   iii. This type of measure often requires risk adjustment to account for differences in patient characteristics that are outside of the control of the entity being measured
   iv. These characteristics vary depending on the intent of the measure and can include items such as severity of illness or co-morbidities

c. In order to develop a clearly defined, precisely specified measure, it is critical that the intent of the measure is well outlined

Teaching Tip
For example, defining the intent of the measure as the quality of care provided to patients with a diagnosis of diabetes would be too broad; rather, if the measure intent was to determine the number of patients with diabetes whose blood pressure is within acceptable targets, it lends itself to developing and specifying a measure.

d. Once the intent of the measure is clearly defined, the different components of the measure should then be specified

(1) These components include
   i. Initial patient population—defines the total population of interest; this may be focused on patients with a specific diagnosis or on procedures that are performed for example
   ii. Denominator—"The lower part of the fraction used to calculate a rate or ratio defining the total population of interest for a quality measure"; often the same as initial patient population but also may be a subset or more narrow focus
   iii. Numerator—"The upper part of the fraction used to calculate a rate or ratio defining the subset of the population of interest that meets a quality measure's criterion of quality." This focuses on the structure, process, or outcome of interest
   iv. Exclusions (also called exceptions)—"Characteristics defined during the delivery of care that would mean that care specified in the numerator was contraindicated, refused by the patient, or not possible for some other compelling and particular circumstance of this case"

e. Within each of these components, specific definitions should be included such as who is being measured (patient population, diagnoses, age, gender if applicable, measurement period, or timeframe), what is being measured (the outcome, process, or structure of interest), and what patients, treatments, or other aspects are not appropriate to include

f. Performance measures are usually calculated as counts ("the number of times the unit of analysis for a measure occurs"), ratios ("a score that may have a value of zero or greater that is derived by dividing a count of one type of data by a count of another type of data"), or rates/proportions ("a score derived by dividing the number of cases that meet a criterion for quality (the numerator) by the number of eligible cases within a given time frame (the denominator) where the numerator cases are a subset of the denominator cases")

g. Within performance measurement, there is an increasing push to design measures to be broadly applicable with the ability to drill down into specific ages groups, conditions, etc. as desired

(1) This type of measurement is more feasible using electronic data

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

What do we Measure?

1. Overview

a. Performance measures typically focus on one of the following areas
- Patient experience—measures that capture how care was provided through the eyes of the patient and/or caregiver
- Quality of care delivered—measures that capture whether care was received in accordance with clinical evidence and guidelines; these measures typically look at overuse, inappropriate use/unnecessary care or underuse
- Access—measures that examine whether a service or treatment was provided and available in a timely manner
- Cost—measures that examine the amount (usually in dollars) spent to provide services, procedures, treatments, etc.

b. While most measures look at one aspect of care such as overuse of services, more and more measures are developed that take an increasingly comprehensive view to reflect how patients truly receive care

(1) These composites are groupings of two or more measures that include processes and/or outcomes of care into a single score

Teaching Tip
For example, a composite of the quality of care a patient with asthma might look at whether the patient is receiving the appropriate treatments as well as the number of emergency department visits she may have had over the last year. Composites can be weighted where the score of one or more measures is given priority over others or calculated as an all-or-none.

- **c.** In light of performance measurement moving to better reflect the care a patient receives, developers, payers, and others continue to explore ways to combine more than one aspect of care

Teaching Tip

For example, there is a growing desire to measure the efficiency of the provider or entity by combining the quality of care received (preferably outcomes) with the resources and the associated cost used to provide that care. Developers, payers, and others have taken this concept a step further to measure value. By combining quality (outcomes) and patient experience over the cost or expenditures to provide that care, it then allows patients, purchasers, employers, and others to make informed decisions on providers or institutions with whom they might want to partner or from whom they want to receive care.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Who do we Measure?

1. Overview
   - **a.** Quality, cost, and other aspects of care are measured at specific levels of analysis and settings of care
     - **(1)** In order to ensure that a measure can be precisely specified, the measure developer will determine which individual or entity to be measured
     - **(2)** This decision is usually made based on the goal of the program or activity for which the measure will be used
     - **(3)** Levels of analysis include the individual level (e.g., nurse, physician), group (e.g., practice, clinic), entity (e.g., hospital, health plan), or at the population level (e.g., measuring across a community or geographic region)
     - **(4)** Understanding what settings of care should be included is critical, particularly when one begins to specify the measure
     - **(5)** Which setting for which the measure is applicable is determined based on the evidence supporting the measure and the intended use of the measure
     - **(6)** Settings of care vary from ambulatory (e.g., clinic, pharmacy, laboratory), inpatient (e.g., hospital, inpatient rehabilitation facility), and other locations including the patient's home

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

How do we Measure?

1. Overview
   - **a.** Performance measures are derived from a variety of sources but are also related to the level of analysis and setting of care for which the measure is intended

Teaching Tip

For example, when measures were created two decades ago, paper medical records were the primary source of information in hospitals and practices. Most measures developed for those groups were specified using that data source. For measures that seek to look at the quality of care provided by a home health agency, the data source may well be the Outcome and Assessment Information Set (OASIS).

   - **b.** There are various data sources including clinical data (i.e., cost, procedures, pharmacy, lab, imaging), medical records (either paper or electronic), patient-reported data (i.e., surveys, portals), registry, and others
     - **(1)** Medical records (either paper or electronic) have been considered the gold standard when measuring a provider's performance but this thinking is evolving, particularly when the patient's experience or perspective is desired, leading to the development of patient-reported data, primarily through surveys
   - **c.** As patient care and quality activities continue to evolve, the emphasis is now on providing access to data that is real time, can be tracked longitudinally, and can be communicated across systems and providers to enhance the coordination of care for patients
     - **(1)** This emphasis has driven much of the adoption and implementation of electronic data sources in healthcare
     - **(2)** Given the increasing implementation of EHR systems in practices, hospitals, and other entities, measures must now be specified using this data source, requiring additional granularity in the specifications, coding, and other aspects, which are outlined further in this chapter

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Who Develops Measures, Why, and in What Environments?

1. Overview
   - **a.** Performance measurement has evolved over the last 10 years
     - **(1)** Initial efforts to capture and use data to define the quality of care provided to patients included groups focused on a providers' quality of care such as The Joint Commission's (TJC) ORYX® program, the National Committee for Quality Assurance's Healthcare Effectiveness Data and Information Set (HEDIS®) program, the AMA-convened Physician Consortium for Performance Improvement (PCPI®) or on a specific condition or disease like the Diabetes Quality Improvement Program
     - **(2)** These programs and associated measures were developed to enable providers and patients to determine the quality of care that hospitals provided through the TJC program, the PCPI for physicians, and health plans with the HEDIS program

    - **(3)** Within the nursing community, the American Nurses Association (ANA) established the National Database of Nursing Quality Indicators (NDNQI) to enable comparison of valid and reliable nursing-sensitive indicators at the national, regional, and state level for comparison down to the unit level
- **b.** Many of these measures were developed to enable quality improvement activities at the point of care—meaning real-time data and feedback to facilitate changes to the care provided to patients
    - **(1)** As the focus shifted to use performance measures for accountability purposes (i.e., pay for reporting and/or performance, public reporting), the healthcare community identified the need for an entity to vet and endorse national standards, which then became the National Quality Forum (NQF)
    - **(2)** This shift created a focus on measures that were more rigorously specified and shown to be reliable and valid to enable patients, employers, purchasers, and others to make informed choices on which entity was provided the highest level of care
    - **(3)** Performance measures are now actively used in federal and state programs to enable patients to identify who provides high-quality care and purchasers and employers to select and partner with them
- **c.** While these developers and programs were focused on public reporting and paying for performance, other smaller groups continued to develop measures for use in national, state, and private programs
    - **(1)** Today, medical specialty societies or accreditors are no longer the primary developers of measures; rather, quality improvement collaboratives serve as a key contributor to measure development and federal agencies such as the Centers for Medicare and Medicaid Services (CMS) and the Office of the National Coordinator for Health Information Technology (ONC) are funding and encouraging groups such as regional collaboratives, and health systems to develop measures that can be derived from electronic sources (i.e., EHRs, registries) and are patient-centered
- **d.** At the end of the day, we cannot improve without knowing where care is lacking
    - **(1)** Performance measurement provides a method by which we can assess where we need to improve our processes that lead to improved patient outcomes
    - **(2)** A goal of measurement is that it be a byproduct of care delivery to the greatest extent possible to enable us to track improvement real time and longitudinally
    - **(3)** By integrating these measures into electronic systems, we will be furthering that goal
    - **(4)** The integration of quality measures within electronic systems requires use of data standards

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

What Are the Quality Reporting Programs?

1. Overview

- **a.** Quality reporting programs have been in existence in healthcare for over a century. Collecting and reporting quality data has become more organized and focused over the past 50 years with a major growth in the past 10–20 years
    - **(1)** Organizations such as the CMS, TJC, the American College of Surgeons, other professional organizations, and state and local quality initiatives, have been major players in moving healthcare quality reporting programs to where we are today
    - **(2)** Many point to the Institute of Medicine's sentinel report *To Err is Human* as a turning point for the rapid growth of quality reporting programs since 2000
    - **(3)** Hospitals, physician offices, pharmacies, ambulatory centers, and others who provide healthcare services to consumers (e.g., laboratories) may be required to report quality data
    - **(4)** Reporting programs have evolved over the past decade but the goal of these programs is to improve patient safety through the use of EHRs
    - **(5)** Nursing informatics professionals can support these efforts through data analytics, program knowledge, and a keen understanding of the data collection and storage in an EHR
- **b.** Historically, claims data has been used to track and monitor patient services
    - **(1)** The data were used to reimburse providers for care
    - **(2)** It also provided data to track quality of care as the information reflected the procedures completed for the patient

Teaching Tip

For example, if a claim was submitted for a patient for an influenza vaccine the provider would get reimbursed and the insurer could track patients who received the preventive service. A standard format for reporting claims data has made it easier to track quality data. However, claims data does not tell the full story of the patient's visit, services provided, and outcomes to adequately describe the quality of clinical care. Using the example above, many consumers receive their influenza vaccine at the local pharmacy or grocery store, their church, or a community-sponsored flu clinic. Most flu clinics, if not free, require a nominal cash payment and the service may not be reported to a provider or an insurer through the claims payment process. Although it may be relatively easy to report the number of doses administered we may not know the ages, gender, race, etc. of the population receiving the vaccine. This data could be collected in an EHR by providers who collect the data during a patient visit.

- **c.** Informatics nurses (IN) and informatics nurse specialists (INS) must be aware of quality programs used at their facility/institution, particularly those programs that rely on clinical data that can be collected and retrieved from the EHR
    - **(1)** The INs and INSs must understand the intent of the quality programs, data requirements, reporting timelines, staff education requirements for data input (data collection) or timing of data input, querying the data,

organizing and interpreting the data, and understanding what the results mean and how to apply it

- **(2)** The INs and INSs must work with organization staff and senior management to understand the results and to develop a strategy to improve or maintain the quality of care based on the quality programs results

d. The sections below will discuss at a high level a few of the current federal quality initiatives, the role of TJC in quality and the NDNQI

- **(1)** Each program has its own criteria
- **(2)** As EHRs mature and evolve and their use becomes more widespread, quality program criteria will change
- **(3)** However, the common goal of quality of care to ensure patient safety will remain steadfast

2. Federal programs to support quality reporting

a. Since the early 2000s, and in conjunction with the growth of EHRs in the inpatient and ambulatory care settings, there has been a movement to collect and report measures using clinical data

- **(1)** The process to convert was slow until incentive programs started by the federal government boosted the movement

b. Included in the American Recovery and Reinvestment Act (ARRA) is the Health Information Technology for Economic and Clinical Health Act (HITECH)

c. HITECH provisions incentive payments by the CMS for reporting of “meaningful use” of certified EHR technology by eligible professionals (EPs), hospitals, and critical access hospitals (CAH)

d. The Medicare and Medicaid EHR Incentive Program, more commonly known as Meaningful Use (MU), is the most notable of the current quality reporting programs

- **(1)** The MU program is open to EPs (e.g., individual physicians, nurse practitioners), eligible hospitals (e.g., acute care facilities but not children’s hospitals), and CAH
- **(2)** Providers must demonstrate meaningful use of a certified electronic health system (EHR) while providing patient care

e. The Medicare incentive program is administered by CMS, while the Medicaid incentive programs are administered voluntarily by states and territories

- **(1)** The Medicare MU program for EPs started in 2011 and runs through 2016 with 2014 being the last year to initiate participation in the program
- **(2)** The Medicaid program runs through 2021 with 2016 being the final year to enroll
- **(3)** Providers with a certified EHR system can enroll and participate in either the Medicare or Medicaid MU program but not both

f. Eligible hospitals can participate in the MU hospital incentive programs

- **(1)** Participation started in FY 2011 with payment incentives continuing until FY 2016

g. CMS requires that providers participating in the MU program show they are using their EHR meaningfully

- **(1)** In other words, using an EHR is positively affecting the care they are providing
- **(2)** Providers show meaningful use by meeting all criteria established by CMS for each stage of the program
- **(3)** Meaningful Use had three stages
    - Stage 1: Data capture and sharing data with patients or other healthcare providers
    - Stage 2: Advance clinical processes
    - Stage 3: Improved outcomes

h. Providers must satisfy Stage 1 requirements to obtain financial incentives and move to Stage 2

- **(1)** Stage 1 of MU for eligible providers (e.g., individual physicians) requires reporting data for a consecutive 90-day period during a calendar year
- **(2)** Stage 1 serves as the foundation for Stages 2 and 3
- **(3)** Stage 2 requires providers to submit quality data for one consecutive year for core measures, menu measures, and CQMs
- **(4)** These criteria have been defined as through federal regulations
- **(5)** As of the writing of this chapter, CMS in conjunction with the ONC have proposed extending the end of Stage 2 to 2016 and delaying the start of Stage 3
- **(6)** Federal rule will determine the revised start date. Notice of proposed rulemaking for revisions to Meaningful Use Stages 2 and 3 will be issued in Fall 2014

i. Hospitals enrolled in MU must also submit data on core and menu objectives as well as CQMs

- **(1)** The core and menu objectives and CQMs for hospitals vary from the EPs
- **(2)** For more information on the core and menu objectives it is suggested the reader visit the CMS Web site

j. During each of these stages, providers must meet specific criteria set forth by the program

- **(1)** INs and INSs working at facilities enrolled in this program must be aware of the requirements and the timelines for data submission

Teaching Tip

For example, if data is being submitted for height, weight (list them out), then the IN/INS should be aware of how the data is being entered, that the data is being correctly entered by end users and periodically during the reporting period querying the EHR to ensure the information is reportable. Any deviation from what is expected should trigger a discussion for a plan to correct how the end user is entering the data.

k. A second CMS quality program is the Physician Quality Reporting System, or PQRS, for EPs

- **(1)** The PQRS program uses both financial incentive payments and payment adjustments to promote quality reporting
- **(2)** Information reported is for covered Physician Fee Schedule (PFS) services
- **(3)** Claims data and registry data are used to report quality measures for this program
- **(4)** PQRS participation is voluntary and open to individual providers and group practices

  - **(5)** Participation in PQRS does not satisfy enrollment in CMS's MU program
  - **(6)** Program requirement changes INs and INSs working with providers enrolled in PQRS are encouraged to follow program requirements and changes on the CMS Web site

l. The Hospital Inpatient Quality Reporting (Hospital IQR formerly RHADAPU) program is also a CMS-sponsored quality program

  - **(1)** RHADAPU is a Medicare run program
  - **(2)** Measure data required by this program mirrors common diagnoses seen among hospitalized Medicare patients
  - **(3)** The program looks at clinical and claims data
  - **(4)** It was developed with the goal of providing consumers with information about the quality of care at hospitals
  - **(5)** With this comparison consumers can then make more informed decisions about where to seek care
  - **(6)** Consumers can view this information on the Hospital Compare Web site
  - **(7)** The Hospital IQR program reports and information about how the hospital compares to others facilities provides an opportunity to improve clinical care
  - **(8)** Measure data collected for the Hospital IQR program can also be used for other quality reporting programs such as those of TJC

m. NDNQI is a quality improvement program of the ANA

  - **(1)** The program focuses on nursing measures
  - **(2)** It provides nurses and their leadership with data about where nursing is meeting standards and where it needs to improve patient outcomes
  - **(3)** It also provides healthcare facilities with the ability to compare themselves to similar size and type of facilities at the local, regional, and national levels

n. Unlike other quality reporting programs, the NDNQI uses unit level data

  - **(1)** Information collected and reported quarterly at the unit level includes, but is not limited to: fall/injury fall rate, nursing hours per patient day, nursing skill mix, Peripheral IV infiltration rate, RN Education/Certification, nurse turnover orate, central-line-associated bloodstream infection rate, and pain assessment/intervention/reassessment cycles completed

o. TJC accredits healthcare organizations including but not limited to: hospitals, physician offices, nursing homes, ambulatory health centers, and home care

  - **(1)** TJC's ORYX® program, according to their Web site, "… integrates outcomes and other performance measure data into the accreditation process"
  - **(2)** TJC believes performance measurement data is crucial to accreditation
  - **(3)** They work in concert with the CMS to align measures common to both organizations' quality programs in an effort to decrease the burden and cost of data collection and reporting for healthcare organizations
  - **(4)** ORYX data is published by TJC on their Web site
  - **(5)** The data provides data comparison at the state and national levels
  - **(6)** In addition to using quality measures to accredit organizations, TJC develops quality measures and quality tools

p. HEDIS® is a tool providing measure performance data on care and services based on 80 measures across five domains

  - **(1)** According to the National Committee on Quality Assurance (NCQA), who maintains the program/runs HEDIS, the information is used by 90% of America's health plans as it provides a picture of care provided

Teaching Tip
Examples of measure data collected for HEDIS includes medication management for asthma, blood pressure control, breast cancer screening, and childhood and adolescent immunizations.

  - **(2)** As part of the HEDIS life cycle, measures are evaluated at least every three years to determine if they continue to benefit the program
  - **(3)** Measures that are no longer of value are retired

q. HEDIS data also allows employers and others who provide healthcare plans to analyze performance of the plans so that they may select the plans deemed best for their employees

  - **(1)** The *Quality Compass* tool, available through the NCQA Web site, allows employers to access information and makes comparisons of health plans
  - **(2)** HEDIS data is available in the *State of Health Care Quality* report
  - **(3)** This report provides a thorough, in-depth picture of the nation's healthcare system
  - **(4)** HEDIS data is also used in the "report cards" of health plans found in the news media

r. The Agency for Healthcare Research and Quality (AHRQ), part of the DHHS, states on their Web site: "AHRQ's mission is to produce evidence to make healthcare safer, higher quality, more accessible, equitable, and affordable, and to work with the U.S. Department of Health and Human Services (HHS) and other partners to make sure that the evidence is understood and used"

  - **(1)** To this end, one aspect of AHRQ's work is in the area of quality
  - **(2)** AHRQ supports many programs to improve quality in the inpatient and ambulatory settings
  - **(3)** The AHRQ QIs program uses hospital inpatient administrative data
  - **(4)** Currently, AHRQ QI™ modules include Prevention Quality Indicators, Inpatient Quality Indicators, Patient Safety Indicators, and Pediatric Quality Indicators

s. AHRQ also has an extensive portfolio of quality tools to assist physicians, nurses, and other healthcare providers to improve quality of care

Teaching Tip
For example, through AHRQ's Comprehensive Unit-based Safety Programs (CUSP) hospitals can learn how to reduce the incidence of catheter-associated urinary tract infections (CAUTI), or central line-associated blood stream infections (CABSI). Reduction in the incidence of both these infections will improve patient safety and quality of care.

    - **(1)** It is suggested that the reader refer to AHRQ's Web site for current information on quality programs currently in progress at the Agency
  - **t.** AHRQ provides to the public multiple quality reports
    - **(1)** Among those available on their Web site are the National Healthcare Quality Report (NHQR) and the National Healthcare Disparities Report (NHDR)
    - **(2)** The reports, published annually, "…measure trends in effectiveness of care, patient safety, timeliness of care, patient centeredness, and efficiency of care" per the AHRQ Web site
  - **u.** The National Quality Measures Clearinghouse (NQMC) is an AHRQ initiative
    - **(1)** NQMC's mission is to "…provide practitioners, healthcare providers, health plans, integrated delivery systems, purchasers and others an accessible mechanism for obtaining detailed information on quality measures, and to further their dissemination, implementation, and use in order to inform healthcare decisions"
  - **v.** As quality reporting programs shift from reporting claims data to reporting clinical data to meet program requirements, INs and INSs must be knowledgeable about the local, state, and national programs their organization participates in
    - **(1)** Keeping up with the rapid changes of each program can be a challenge
    - **(2)** Working with your organization's quality department, checking program Web sites, participating in publically available Webinars and seminars, etc., will help to keep you informed of the most current program requirements
    - **(3)** As INs and INSs it may be your responsibility to ensure the data elements are in the EHR, the data is being entered in discrete fields in a timely manner, is extracted periodically to review, understand reporting program deadlines, being able to interpret the data, and recommend to management processes to improve quality of care and patient safety

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Why Are Standards Important?

- **1.** Overview
  - **a.** Data collected in an EHR are often identified by local, idiosyncratic, and sometimes redundant and/or ambiguous names rather than unique, well-organized codes from standard code systems
    - **(1)** Without standardized dialogue boxes, drop-down lists, or other pre-defined menu options, there is no consistency in the content captured in free-text fields
    - **(2)** As such, comparisons of entries across patients, providers, or other systems are exceedingly challenging and even with the use of sophisticated coding tools and analytics to interpret the underlying content, may be inaccurate
    - **(3)** Hospitals, clinics, and other healthcare entities must devote significant resources to document, abstract, and report these mandated performance measures
    - **(4)** It is conservatively estimated that hospitals spend 22.2 minutes per heart failure case to abstract the data, which in aggregate amounts to more than 400,000 person-hours spent each year by US hospitals
  - **b.** Retrieving data for quality measurement is challenging
    - **(1)** The process is mostly retrospective
    - **(2)** Data are stored in different sources in the EHR and there are different kinds of data that do not map
    - **(3)** In essence, humans are creating the data after analyzing different terms and codes in the EHR
    - **(4)** Data and information standards are needed to solve these problems
- **2.** Overview of standards
  - **a.** Standards can be defined as any norm, convention, or requirement that is universally agreed upon by participating entities
    - **(1)** Many of us are familiar with standards even though we may not realize it

Teaching Tip

Many may remember the days prior to the proliferation of IT in banking: one had to plan ahead for an international trip and purchase travelers checks.

Today, one can hop on a plane on a whim and be able to purchase dinner in Kiev on a credit card and withdraw cash from an ATM with a debit card—doing so securely and being assured a fair exchange rate. With standards that are applied across an industry, for instance the use of SWIFT standards in banking, one can easily see the advantages to standardization. The ability to access money in a checking account from India on Tuesday and Italy on Thursday is an excellent example. IT has been a huge catalyst that has both enabled and enforced this standardization within banking.

Teaching Tip

We are all familiar with areas, beyond healthcare, that are lacking in standardization. The simple act of purchasing shoes or clothing made outside of the United States can be a frustrating experience. If one does not know their European size or have access to a chart to convert from US to other sizes, the deal may not go through. This simple example highlights the need for standardization. As we look to healthcare and its current struggle to standardize, it is easier to understand why this issue is so important. In our clothing example, the chances that someone may be injured or die as a result of a lack of standardization are highly unlikely. In healthcare, the risk is eminent. There are many organizations that seek to help with this standardization in healthcare. One of the most important standardization organizations in electronic quality measurement is Health Level 7 (HL7), which will be described in the next section.

- **3.** Overview of Health Level 7 (HL7)
  - **a.** The Health Level 7 (commonly referred to as HL7) organization came into existence in 1987 to begin solving standards issues in healthcare

  - **(1)** HL7 is a nonprofit organization that includes both corporate and individual members from all domains of healthcare
  - **(2)** It is an American National Standards Institute (ANSI) accredited standards developing organization that focuses on creating and maintaining a framework of related standards for the exchange, integration, sharing, and retrieval of electronic health information
- **b.** HL7 operates through volunteer work groups of professionals and one such group, the Clinical Quality Information Workgroup is working closely with ONC and CMS to create and maintain IT standards in support of improving healthcare quality, including clinical care, and to foster collaboration between quality measurement, outcomes, and improvement stakeholders
  - **(1)** To this end, several projects are currently underway to help streamline the quality measurement development process
  - **(2)** There are three key projects
    - **i.** *Harmonization of a common data model* (sourced from many of the current models in use like the Virtual Medical Record (vMR) and the Quality Data Model (QDM) for quality that can be used for quality measures and clinical decision support [CDS])
    - **ii.** *Harmonization of an expression language* that will allow measure developers to express certain mathematical and time-related concepts that are important in measurement in a way that is easily understood and carried out by implementers
    - **iii.** *Development of a common set of metadata* (with definitions) that can be used in measure development

4. HL7 source data standards
- **a.** HL7 has several primary standards that have led to the development of data standards around quality measurement
  - **(1)** The Reference Information Model (RIM) is the foundation of much of HL7's development work
  - **(2)** The RIM is a large, pictorial representation of the HL7 clinical data domains and identifies the life cycle of information
- **b.** HL7 standards pertain to four key areas of health information exchange: conceptual standards like the RIM, document standards (e.g., HL7 Consolidated Document Architecture), application standards and messaging standards (e.g., HL7 v2.x and v3.0)
  - **(1)** This section will focus on document and messaging standards as they pertain to quality measurement
- **c.** From the RIM, many of HL7's primary standards have been developed
  - **(1)** Important among those are the Version 2 (v2) and Version 3 (v3) Product Suites
  - **(2)** The v2-messaging standard is considered the most widely adopted and used standard in the HL7 product line
  - **(3)** This standard is the foundation of electronic data exchange and has been widely implemented in 95% of US healthcare organizations to date
- **d.** With the release of v3, HL7 attempted to move toward a more standardized programming language with the use of extensible markup language (XML)
  - **(1)** This use of XML makes v3 more human readable while maintained machine readability with the same data set
  - **(2)** Unfortunately, there is no backwards compatibility between v2 and v3, which has created challenges as v2 has been widely adopted in the United States and v3 has been adopted internationally
- **e.** The Clinical Document Architecture (CDA®) is a document markup standard that specifies the structure and semantics of clinical documents for the purpose of exchange between healthcare providers and patients
  - **(1)** CDA states that a clinical document must contain certain key characteristics:
    - **i.** Persistence
    - **ii.** Stewardship
    - **iii.** Potential for authentication
    - **iv.** Context
    - **v.** Wholeness
    - **vi.** Human readability

5. HL7 data standards in quality measurement
- **a.** From these source standards within HL7, specifically CDA, two important document standards have been developed to enable quality measurement
  - **(1)** The Health Quality Measure Format or HQMF is the document standard for coding and representing an eMeasure
  - **(2)** The HQMF is used by measure developers to define a CQM that is consumable by both a computer and a human
- **b.** The Quality Reporting Document Architecture or QRDA is the document standard for reporting the data that is determined to have met the criteria of the eMeasure
  - **(1)** The QRDA standard has three levels of reporting capability: category I, II, and III
  - **(2)** QRDA Category I is a patient level report that contains the clinical information specified in the measure for one patient
  - **(3)** A QRDA level II will have multi-patient information across a defined population that may or may not identify individual patient data within the summary
  - **(4)** Lastly, a QRDA level III report is an aggregate quality report with a result for a given population and period of time
  - **(5)** One can think of the QRDA as the result of a CQM from the EHR
  - **(6)** It is then generally submitted to CMS or any other requesting or reporting agency
- **c.** The QRDA standard is referenced in the certification criteria for EHRs set forth by ONC
  - **(1)** As part of the meaningful use legislation, providers and hospitals must use EHR technology that is certified by the federal government to meet certain standards and criteria
  - **(2)** The QRDA standard is one of many HL7 standards that are referenced in these criteria

6. Value sets and Value Set Authority Center

  a. Value sets can be defined lists of specific values (terms and their codes) derived from single or multiple standard vocabularies used to define clinical concepts (e.g., patients with diabetes, clinical visit, reportable diseases) used in CQMs and to support effective health information exchange

    (1) Some of the standard vocabularies (or terminologies) used to define these value sets will be discussed in the next section

    (2) Value sets are developed by measure developers and are ideally shared across developers

    (3) Each value set is represented by a unique object identifier (OID) that is registered on the HL7 Web site

    (4) Until October 2013, value sets were created and maintained in the Measure Authoring Tool (MAT)

    (5) Since late October 2013, the value sets for the 2014 CQMs were migrated to the new Value Set Authority Center (VSAC), which can be accessed at www.vsac.nlm.nih.gov

  b. The Value Set Authority Center (VSAC) serves as the official repository of the value sets for the Meaningful Use 2014 CQMs and is maintained by the National Library of Medicine (NLM), in collaboration with the ONC and CMS

    (1) Search, retrieval, and download capabilities are provided through a Web interface and APIs

    (2) The VSAC also provides authoring tools for users to create value sets related to quality measures

7. Terminology standards

  a. There are many terminologies currently in wide use within healthcare to represent clinical aspects or data types

    (1) All of these terminologies require a common format or standard to ensure that communication and transmission of data in the electronic realm is as clear as possible due to the increasing focus on collecting and sharing data across systems and for quality improvement and accountability purposes

    (2) There are several terminologies that play key roles in the representation of clinical care within EHRs and there are many mappings across the various terminologies to enable data sharing and valid representations of this data across settings and providers

  b. The Systemized Nomenclature of Medicine—Clinical Terms (SNOMED CT) is comprehensive, multilingual healthcare terminology

    (1) SNOMED CT is important in EHR development and use as it allows for the recording of clinical data in ways that enable meaning-based retrieval, is mapped to other code sets that may be used in specific healthcare settings (e.g., LOINC), and certification and other standard setting organizations are encouraging the use of this terminology in performance measures

    (2) Other code systems that are frequently used in performance measures include

      - LOINC® or the Logical Observation Identifiers Names and Codes—a universal code system for identifying laboratory and clinical observations
      - RxNorm—pertains specifically to medications and acts as a normalized naming system for generic and branded drugs
      - International Classification of Diseases (ICD)—the classification used to code and classify diseases and other health characteristics
      - Current Procedural Terminology (CPT)—a code system that reports procedures, office, emergency departments and other visits, and other services provided by healthcare professionals
      - The International Classification of Diseases (ICD)—a code system used to classify diseases and other health problems for health records and other vital records. The structure enables storage and retrieval of diagnostic information for quality, clinical, and other purposes

8. Quality Data Model (QDM)

  a. Once a measure developer has determined the clinical concepts in a quality measure and has built the associated value sets, use of the QDM will enable expression of performance measurement data for electronic measurement

    (1) The QDM can be thought of as a backbone for representation of quality criteria used in clinical guidelines, quality measures, and CDS and is used by stakeholders involved in electronic quality measurement and reporting, such as measure developers, federal agencies, health IT vendors, standards organizations, informatics experts, providers, and researchers

    (2) The QDM also makes up the logical portion of the Measure Authoring Tool or MAT

    (3) The QDM is currently being harmonized, through efforts in HL7, with other logical models to enhance its capabilities and expressiveness

9. eCQM life cycle (from measurement to improvement)

  a. Medicare and Medicaid EHR Incentive Programs provide financial incentives for the “Meaningful Use” of certified EHR technology to improve patient care

    (1) Achieving meaningful use of EHRs for quality measurement, reporting, and improvement requires the use of standards to integrate quality measures within EHRs for real-time quality reporting

    (2) This involves a series of steps as depicted in the Quality Management Life Cycle in Figure 38.1

  b. The steps in the Quality Management Life Cycle will be described by applying the data standards presented in this chapter to an eMeasure from the MU incentive program

    (1) The quality measure was developed by TJC and assesses “the number of patients diagnosed with confirmed VTE who received an overlap of Parenteral (intravenous [IV] or subcutaneous anticoagulation and warfarin therapy)”

    (2) This measure involves all members of the clinical team and has implications for nursing practice

    (3) The life cycle of a quality measure, from standardized representation of measure concepts and logic, to integration within the EHR and generation of quality reports will be described

    (4) This description will be extended to show how the EHR can leverage data standards to support total quality management for venous thromboembolism (VTE) care as it pertains to nursing practice

c. The eMeasure life cycle includes the following step for Measure Title: Venous Thromboembolism Patients with Anticoagulant Overlap Therapy, Steward: The Joint Commission

- **(1)** First, the intent of the measure is clearly and specifically defined as follows
    - **i.** "For patients who received less than five days of overlap therapy, they should be discharged on both medications or have a reason for discontinuation of overlap therapy. Overlap therapy should be administered for at least five days with an international normalized ratio (INR) greater than or equal to 2 prior to discontinuation of the parenteral anticoagulation therapy, discharged on both medications or have a reason for discontinuation of overlap therapy"
- **(2)** Once the measure intent is defined, the different components of the measure are then specified—"who" is being measured and "what" is being measured. The components of this measure include the:
    - **i.** Initial patient population of interest: Patients with a diagnosis code for VTE with a patient age greater than or equal to 18 years, and a length of stay less than or equal to 120 days
    - **ii.** Denominator: Patients with confirmed VTE who received warfarin
    - **iii.** Numerator: Patients who received overlap therapy (warfarin or parenteral anticoagulation):
        - ◦ Five or more days, with an INR greater than or equal to 2 prior to discontinuation or parenteral therapy, or
        - ◦ Five or more days, with an INR less than 2 and discharged on overlap therapy, or
        - ◦ Less than five days and discharged on overlap therapy, or
        - ◦ With documentation of reason for discontinuation of overlap therapy, or
        - ◦ With documentation of a reason for no overlap therapy
    - **iv.** Denominator Exclusions
        - ◦ Patients less than 18 years of age
        - ◦ Patients who have a length of stay greater than 120 days
        - ◦ Patients with Comfort Measures Only documented
        - ◦ Patients enrolled in clinical trials
        - ◦ Patients discharged to a healthcare facility for hospice care
        - ◦ Patients discharged to home for hospice care
        - ◦ Patients who expired
        - ◦ Patients who left against medical advice
        - ◦ Patients discharged to another hospital
        - ◦ Patients without warfarin therapy during hospitalization
        - ◦ Patients without VTE confirmed by diagnostic testing

d. The level of granularity provides useful information for EHR designers, so they can start mapping quality measure concepts, such as "documentation of a reason for discontinuation of overlap therapy," to EHR functionality such as "addition of reason for discontinuation of overlap therapy"

- **(1)** Furthermore, some of the measure components relate to nursing documentation such as "documentation of patients who are receiving comfort measures only"

e. After the measure is specified, indicating "who" is being measured and "what" is being measured, the measure needs to be further defined using standardized codes (QDM, SNOMED CT, LOINC, RxNorm, and CPT) for concepts contained within the measure (confirmed diagnosis of VTE, comfort measures, etc.), as well as standardized expression language (HTML and XML) to represent the logic contained within the measure (patients who received less than five days of overlap therapy, should be discharged on both medications or have a reason for discontinuation of overlap therapy)

- **(1)** This is accomplished with HQMF, which defines a representation of the quality measure that is consumable by both a human and computer
- **(2)** This expression can be described in three ways
    - **i.** A human readable format (HTML) allows users to understand how the elements are defined and the underlying logic used to calculate the measure. This is useful when EHR designers, quality experts, clinicians, and the leadership team are making decisions about how the measures will be integrated within electronic systems. The human readable format provides a common language for all professionals involved in healthcare
    - **ii.** A computer readable format (XML) enables the creation of automated queries against electronic systems for quality reporting (QRDA). Ideally electronic systems read the XML and will generate the QRDA for reporting
    - **iii.** A list of the specific codes (SNOMED CT, QDM, RxNorm, ICD10, CPT) used by developers of electronic systems to ensure that accurate, valid, and reliable data capture can be supported (diagnoses, medications). The list of codes is referred to as "value sets." These value sets are contained within dictionaries (or concept repositories) of electronic health systems. The applications contained within electronic systems use the codes to process logic contained within the quality measures to generate quality reports (QRDA) necessary for MU

f. With this infrastructure, a vast array of healthcare data can be reported and analyzed, thereby turning data into knowledge that can be put to immediate use

- **(1)** This quality measurement infrastructure can help to make advances toward becoming a learning health system

g. In summary, the eMeasure supports quality reporting for MU but can also support real-time decision-making, performance improvement and overall quality management

Teaching Tip

Two examples follow

1. The eMeasure content can be used to guide CDS through automatic alerts and reminders. For instance, this measure states that patients who receive less than five days of overlap therapy should be discharged on both medications or have a reason for discontinuation of overlap therapy. Electronic systems can use this content to alert the clinician at time of discharge to act in accordance with the measure.
2. EHR designers can integrate the measure rationale within EHRS to facilitate education and CDS. Clinicians can access the rationale from within the EHR. For this measure the rationale is as follows:

For patients who present with a confirmed acute VTE, parenteral anticoagulation is the first line of therapy because of its rapid onset of action. Because the oral anticoagulant warfarin has a very slow onset of action, it cannot be used as mono-therapy for acute VTE. Pretreatment with parenteral anticoagulants prior to initiation of warfarin also avoids an early period of hypercoagulability that can result from the selective inhibition of proteins S and C (which have very short half lives). Warfarin can be initiated on the first day of treatment after the first dose of a parenteral anticoagulant has been given. Warfarin interferes with the synthesis of vitamin K dependent pro-coagulant factors (factors II, VII, IX, and X) as well as some anticoagulant factors (proteins S and C). It takes several days for warfarin to achieve its effect because time is required for normal coagulation factors to be cleared from plasma. The adequacy of warfarin therapy is monitored by measurement of the international normalized ratio (INR). The INR can sometimes appear prolonged (or "therapeutic") as soon as 24 hours after the institution of warfarin due to a reduction in factor VII levels, even while factor II levels are still high and the patient is not in fact therapeutically anticoagulated. Because factor II has a half-life of 60–72 hours, a minimum of five days of parenteral anticoagulation is recommended as "overlap therapy" while warfarin is being initiated. Parenteral therapy should also be continued until the INR is greater than or equal to 2.0, even if this takes longer than five days, so that patients are fully anticoagulated during the period before warfarin takes its full effect.

Teaching Tip

This measure has implications for nursing practice. Some of the data necessary for calculation of the measure are derived from documentation performed by nurses. Nurses, in providing care to patients with VTE, document additional data related to the prevention and management of VTE. The infrastructure related to MU code sets, such as SNOMED CT (which includes recognized nursing terminologies), can be used to support coding of nursing data.

Teaching Tip

The CQMs represent conditions reflective of nursing practice. For each of conditions contained within the CQMs, nursing care is provided and frequently represented within the care plan. The care plan can be structured within the EHR using standardized terminology such as Clinical Care Classification (see Fig. 38.2). This shows how nursing practice and documentation support reporting on conditions represented within the eCQM for MU.

h. The value of using the data infrastructure as described above include

  (1) Enhanced decision-making (use the above measure to alert a nurse that patients' who receive less than five days of overlap therapy, should be discharged on both medications or have a reason for discontinuation of overlap therapy). Once the medications are ordered, the electronic system can populate the patient care plan with interventions as depicted in Fig. 38.2

  (2) Creation of nursing dashboards to answer such questions as "How many patients received discharge education?" The electronic dashboards can be used for a total quality management program to enhance quality and safety

  (3) Streamlined measurement and comprehensive exchange between systems so that the nursing impact on outcomes can be compared across settings, the nation, and internationally

  (4) Generation of new knowledge to advance nursing practice

  (5) Effective use of EHRs to support both care delivery and performance improvement

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- In this chapter, we have described what quality measurement is and the move from traditional paper-based abstraction of this information to the use of standards and terminologies to enable electronic capture of real-time data for quality improvement purposes
- Standards and terminologies continue to evolve with the increased implementation and the potential uses for nursing care have not yet been fully realized
- While many national programs currently focus on those individuals and entities that are paid based on the services provided (i.e., physicians, hospitals), there are many opportunities to leverage the data used for quality measurement to enhance the care provided by nurses today as outlined in the example provided at the end of this chapter

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe what a quality measure is, the different types of measures, and the data from which they can be derived
- Discuss why it is important to measure the quality of care, who has historically been involved in measurement development, and the different uses of measures

- Describe the major government and other standards initiatives in quality measurement data infrastructure
- Discuss the role of standard terminologies in quality measurement
- Describe how clinical quality measures support Meaningful Use of electronic health records (EHRs) and quality management
- Describe the development of an eMeasure, its format, and its potential uses for quality improvement and nursing care

Teaching Tip

Ask the students to define the keywords

- Quality management
- Electronic clinical quality measures
- Meaningful Use (MU)
- Performance measurement
- Performance improvement
- Clinical decision support
- Quality reporting
- Electronic health records
- Structured terminology
- Standards organizations
- Nursing quality reporting

CHAPTER REVIEW QUESTIONS

Question 38.1: What is a clinical quality measure?

a. Clinical data elements that ensure that the healthcare delivery system can deliver effective, safe, efficient, patient-centered, equitable, and timely care
b. Financial data elements only that measure the cost of the healthcare delivery system
c. Guideline evidence data elements only that can measure the outcomes of the healthcare delivery system
d. None of the above

Question 38.2: What are the constructs or types of measures that are used to measure performance of individuals or institutions?

a. Performance, quality, and risks
b. Performance, risks, and safety
c. Structure, process, and outcome
d. Structure, performance, and risks

Question 38.3: Which regulatory agency is involved in quality measures?

a. CMS
b. AHRQ
c. HHS
d. National Quality Forum

Question 38.4: Which nonregulatory agency is involved in quality measures?

a. NLM
b. CMS
c. FDA
d. None of the above

Question 38.5: What are performance measures usually focused on?

a. Policies, processes, IT architecture, and outcomes
b. Patient experience, quality of care delivered, access, and cost
c. Cost, effectiveness, efficiency, and quality
d. Cost, policies, processes, and staffing ratios

Question 38.6: In what agency of the government can you find the value sets for the clinical quality measures?

a. The National Quality Forum
b. The National Library of Medicine
c. The National Archives
d. The Joint Commission

Question 38.7: What is the CDA?

a. The Clinical Document Architecture (CDA®) is a document markup standard that specifies the structure and semantics of clinical documents for the purpose of exchange between healthcare providers and patients
b. The Clinical Data Architecture for the purpose of defining the elements in an EHR
c. The Clinical Data Assembly where people gather to define the eMeasures
d. The Clinical Document Assurance Program to assure compliance in quality measures

Question 38.8: Which Standards Organization developed the Health Quality Measure Format?

a. ONC
b. CCC
c. ANSI
d. HL7

Question 38.9: Which national nursing organization established the National Database of Nursing Quality Indicators?

a. The American Nurses Informatics Association
b. The American Nurses Association
c. The American Medical Informatics Association
d. The National Quality Forum

Question 38.10: Health Plans measure quality through what measures?

a. ORYX®
b. HEDIS
c. SNOMED CT
d. CPT

ANSWERS AND EXPLANATIONS

Question 38.1: (a) Clinical data elements that ensure that the healthcare delivery system can deliver effective, safe, efficient, patient-centered, equitable, and timely care.

Question 38.2: (c) Structure, process, and outcomes are the constructs or types of measures for quality.

Question 38.3: (a) The regulatory agency is CMS.

Question 38.4: (a) The NLM is nonregulatory.

Question 38.5: (b) Patient experience, quality of care delivered, access, and cost.

Question 38.6: (b) The Value Set Authority Center (VSAC) serves as the official repository of the value sets for the Meaningful Use 2014 Clinical Quality Measures (CQMs) and is maintained by the National Library of Medicine (NLM).

Question 38.7: (a) The Clinical Document Architecture (CDA®) is a document markup standard that specifies the structure and semantics of clinical documents for the purpose of exchange between healthcare providers and patients.

Question 38.8: (d) HL7 developed the Health Quality Measure Format or HQMF is the document standard for coding and representing an eMeasure.

Question 38.9: (b) The American Nurses Association (ANA) established the National Database of Nursing Quality Indicators to enable comparison of valid and reliable nursing-sensitive indicators at the national, regional, and state level for comparison down to the unit level.

Question 38.10: (b) HEDIS.

39

Translation of Evidence into Nursing Practice

• OBJECTIVES

1. Understand translational science and closely related terminology.
2. Identify tools supporting the translation of evidence at the data, information, knowledge, and wisdom meta-structure levels.
3. Describe evolution of evidence-based practice and evolving trends in the translation of evidence into practice.
4. Describe how informatics is used as a tool to promote and facilitate knowledge generation and translation in practice.
5. Describe models and frameworks connecting critical thinking to processes that support the use of evidence into nursing practice.
6. Discuss how informatics tools serve to promote the use of evidence and the application of knowledge in practice.
7. Identify professional nursing groups and networks that help expand and improve resources to assist in translating evidence into nursing practice.
8. Discuss how professional nurses might engage in advancing the next steps and how informatics tools can be used to deliver evidence into nursing practice.

• KEY WORDS

Evidence
Knowledge generation
Clinical practice guidelines
Evidence-based practice tools
Meaningful use
Performance metrics
Quality and safety of patient care

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions about the class, such as the following: What is the definition of evidence? Can you give examples of evidence? Why is evidence important in healthcare? What is the role of research in the development of evidence-based practice? How do nurses use evidence in the delivery of nursing care? What is the definition of translation? Can you provide examples of translation? Why is translation of evidence important in healthcare and nursing?

For a WIIFM statement, say to the class, "This chapter focuses on the translation of evidence into practice and how translation intersects with technology." As a nurse, it is important to understand evidence-based practice and the role of informatics.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
   - **a.** The nursing discipline has evolved from the days when research was left to those in academe
     - **(1)** An increased emphasis on evidence-based practice (EBP) now requires nurses at all levels to engage in EBP
     - **(2)** For a nurse practicing across inpatient, ambulatory, home, and other settings as well as education, administration, and research, it can be challenging to keep up with both the latest technology as well as new scientific publications
     - **(3)** Yet staying current is central to safe and high-quality care even though care based on evidence is not always the norm
     - **(4)** Although nurses in different settings may consider different types of information to be "evidence," the profession is rapidly learning together how human and electronic information resources as well as print information resources contribute to improved outcomes
     - **(5)** Informatics facilitates this journey by strengthening the merger of evidence with technology in convenient, yet transformative, ways
     - **(6)** This chapter focuses on the translation of evidence into practice and how translation intersects with technology

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Defining Evidence, Implementation and Translational Sciences

1. **Overview**
   - **a.** EBP adds action to the use of evidence
     - **(1)** EBP provides processes for using evidence to generate knowledge
     - **(2)** It is a widely used term that is easier to define than to operationalize
     - **(3)** When defining EBP, Melnyk and Fineout-Overholt highlight the importance of using evidence to support decisions by saying that EBP is a "problem solving approach to clinical decision-making that involves the conscientious use of the best available evidence (including a systematic search for and critical appraisal of the most relevant evidence) to answer a clinical question with one's own clinical expertise along with patient values and preferences to improve outcomes for individuals, groups, communities and systems"
     - **(4)** EBP has many siblings and the distinctions can be confusing
     - **(5)** *Implementation science is the study of methods to promote the integration of research findings and evidence into healthcare policy and practice*
     - **(6)** Implementation science is a growing field that is both multifaceted and complex
     - **(7)** It is especially relevant to nurses and others who work directly with patients since it focuses on what is needed to improve outcomes
   - **b.** EBP is also central to what Titler and Everett define as "translational research," which tests the effect of interventions to facilitate the rate and extent to which evidence-based practices are adopted
     - **(1)** Translational research and implementation science, both capture the significance of key variables that influence EBP
     - **(2)** These variables are part of the local environmental context that so often complicates the implementation of evidence, such as introducing a new intervention based on a current clinical practice guideline recommendation with the goal of assimilating the intervention into routine clinical practice
     - **(3)** Since there is no one standard international terminology that conclusively defines translation, sorting out the definitions can be overwhelming
     - **(4)** Yet understanding the commonly used terms associated with evidence-driven care are potentially valuable since adhering only to one way of thinking about evidence misses what these terms have in common
     - **(5)** The collective actions associated with terms like EBP, implementation science, translational research, knowledge translation, and related terms share a goal to move science close to what makes a difference for patients and populations
     - **(6)** These actions can be simplified into the term "translation"
     - **(7)** Although defined in different ways, translation emphasizes processes such as dissemination and implementation of empirical, patient-centered findings that have been rigorously tested in broad populations and subgroups before deemed ready for implementation in clinical practice
     - **(8)** Feedback and evaluation often follow implementation
     - **(9)** As evidence moves through dissemination, implementation, evaluation, and other stages, evidence-driven care is fostered through iterative and interactive processes
     - **(10)** Although there is growing awareness of the importance of evidence uptake, we are in the early stages of knowing how to systematically operationalize translation and sustain improvements after safety- and quality-related interventions end
     - **(11)** But much is being learned and technology offers momentum
     - **(12)** Struggling with what it takes to apply evidence in ways that promote lasting, safe, cost-effective, and high-quality care is gradually leading to measurable outcome improvements

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Tools Used for Supporting Translation of Data to Information to Knowledge to Wisdom

1. **Overview**
   - **a.** Nursing is an information-based discipline
     - **(1)** Nursing informatics unites nursing science, computer science, and information science in ways that transform what this means
     - **(2)** The evolution of nursing as an information-based discipline changes how data, information, and knowledge are managed in nursing practice

Teaching Tip
Refer to Figure 39.1 regarding the relationship of data, information, knowledge, and wisdom and illustrate examples of tools facilitating translation at each informatics meta-structure level.

- **(3)** The actions occurring as data are transformed into information, knowledge, and wisdom are dynamic and iterative
- **(4)** What is learned through research, evaluation, quality improvement, and safety activities contributes to wisdom
- **(5)** Once wisdom is achieved, feedback contributes to ongoing improvements and to generate new hypotheses

Teaching Tip
Refer to Figure 39.1 which provides tools facilitating translation at each informatics meta-structure level.

- **b.** In an evolving healthcare system, nurses' information needs are fluid and evolve. The development of knowledge accompanies the use of evidence
  - **(1)** But only recently the scientific knowledge base relevant to translational research and implementation science has been strong enough to support use of specific evidence-based tools and strategies during translation as well as address how local factors, such as attitudes toward EBP, influence translation
  - **(2)** Measurement of the impact of using a specific evidence-based tool aids in ongoing understanding of the barriers and facilitators that influence sustained improvements
  - **(3)** Peer-reviewed publications reporting the results of measuring impact adds to the relevance of the scientific knowledge base
  - **(4)** Nurses are in the early stages of identifying best practices as well as gaps in the body of knowledge related to Health Information Technology (HIT) implementation
  - **(5)** As innovations spread, more will be known about how to tailor HIT tools to a local setting, including better understanding about how to adjust implementation strategies based on factors associated with the nursing

2. Evolution of evidence
   - **a.** How evidence is generated?
     - **(1)** Research results can be used to address important clinical questions after being accepted as part of the evidence base for a clinical question
     - **(2)** Research results become part of the evidence base for a disease or condition only after going through rigorous and explicit processes designed to find, compare, and combine data
     - **(3)** Reviews of research findings involve critical appraisal using explicit and objective inclusion and exclusion criteria
     - **(4)** Such criteria identifies studies to be considered when trying to answer a clinical question, such as which nursing interventions for reducing pain are the most effective and scientifically grounded
     - **(5)** An organized approach is used to identify valid and reliable peer-reviewed publications to be considered further
     - **(6)** Rigorous methods determine the efficacy of specific interventions and their effectiveness when used with real patients outside of tightly controlled conditions
   - **b.** Advanced statistical analysis, using Bayesian or other methods, helps understand how best to combine findings
     - **(1)** Through these techniques, systematic reviews pull together what is known about the benefits and harms of the interventions surrounding a clinical question
     - **(2)** Credible methodology helps reveal the trade-offs associated with key treatment, diagnostic, or prevention interventions
     - **(3)** The cumulative findings associated with specific questions can then be reviewed and rated by unbiased experts
     - **(4)** Typically, ratings are accomplished by a multidisciplinary expert team
     - **(5)** A team's systematic review often results in rated recommendations about what does and does not contribute to improved outcomes
   - **c.** Evidence is rated by experts using one of several methods

Teaching Tip
Refer to Table 39.1 which shows the US Preventive Services Task Force's (USPSTF) widely used grading scheme applied to suggestions for practice.

- **(1)** The methods used by USPSTF and other credible groups are revised over time as methods evolve
- **(2)** The USPSTF assigns an A, B, C, D, or I letter grade to signify the strength of each recommendation that comes from synthesizing research findings

Teaching Tip
Refer to Table 39.1 which shows suggested practice for each letter grade.

- **(3)** The graded recommendations produced through this process can be used as the basis for evidence-based tools, such as clinical practice guidelines
- **(4)** During 2012, the USPSTF updated its definition for grade C recommendations, which can be the most complex for clinicians to implement

  - **(5)** The basic meaning of the C recommendation indicates that the net weight of benefits and harms is very close and needs to be considered within the context of conditions, circumstances, and preferences
  - **(6)** While the statistical magnitude of net benefit for a C recommendation is considered small, it may or may not seem small to an individual patient or family or in the eyes of the providers caring for the patient or to the community as a whole
  - **(7)** Values can influence how a specific clinical choice is viewed
  - **(8)** In these cases, the USPSTF recommends "selectively" providing the service—meaning that patient and community preferences, clinician input, and costs may rise in importance
  - **(9)** In these instances, it is especially important to guard against the potential for bias
  - **(10)** Bias arises from conflicts of interest or other avenues that risk the integrity of the processes involved with synthesizing evidence and using this evidence to create evidence-based tools
  - **(11)** Bias can influence ultimate credibility of the final products and can occur at any point between the selection of research findings through translation and evaluation
- **d.** The availability of evidence and evidence-based tools is only the beginning. The US Centers for Disease Control and Prevention (CDC) provides a representation showing the convergence of evidence synthesis with expert judgment

Teaching Tip
Refer to Figure 39.2 which shows a conceptual framework nurses can use when planning and improving evidence-based practices.

  - **(1)** A nurse can apply this model by rating the quality/strength of evidence as weak, moderate, strong, or rigorous
  - **(2)** This rating is associated with the potential impact of applying the EBP in a clinical setting
  - **(3)** The quality of the evidence is interpreted with consideration given to impact
  - **(4)** Impact is quantified in terms of effectiveness, reach, feasibility, sustainability, and transferability
  - **(5)** Within this framework, the term "impact" goes beyond traditional ideas of clinical significance or clinical importance, which focus on whether a nurse or other clinician would alter their practice based on the statistical significance of research findings
  - **(6)** Frameworks of this kind make it easier to communicate about the potential use or rejection of the interventions identified as "best practices" when evidence and judgment are combined
  - **(7)** The use of a framework and common terms aids accountability and transparency about how decisions were reached
  - **(8)** Early in the application of a framework, such as CDC's conceptual framework, nurses way want to discuss how terms like "impact" and "clinical significance" are defined by members of the clinical team and by the patients and family members involved

Teaching Tip
Refer to Figure 39.2, A conceptual framework for planning and improving evidence-based practices.

3. The origins of Evidence-Based Practice
- **a.** EBP employs a systematic approach to clinical decision-making using the best evidence
  - **(1)** Although nurses have long promoted rational choice based on current research findings, the use of a systematic approach to finding and applying evidence as the basis for decisions has only been emphasized over the past 25 years
  - **(2)** Throughout the 1990s, ideas about how to find and use research results evolved
  - **(3)** The term EBP became popular after 1992 when first used by Gordon Guyatt and a group he led at McMaster University
  - **(4)** David L. Sackett described EBP as the best use of current best evidence in making decisions about the care of individual patients
  - **(5)** Over time, EBP came to describe a systematic approach to organizing, collecting, and using research findings in ways that contribute to the best possible outcomes
  - **(6)** As this occurred, nursing roles were revitalized as informatics brought clinical decision support and other tools closer to the bedside
- **b.** As methods for synthesizing evidence improved, literature searches and reviews, meta-analysis, evidence reviews, and evidence-based tools proliferated
  - **(1)** Such synthesized evidence in the form of review papers and similar formats are of growing relevance to nurses since multiple studies and multiple applications are included

Teaching Tip
But the methodological challenges are significant as we try to generalize evidence across groups and settings. Can recommendations from a guideline that applies to men automatically be used with women? Is an intervention more clinically significant than another if they are equal statistically yet one is preferred (over the other) strongly by patients? If an implementation strategy worked in an inpatient setting, can it be used in an ambulatory setting? Answers to these and a host of similar questions are sought as the knowledge base associated with EBP grows and reveals conditions that foster sustained improvement in specific settings.

Teaching Tip
For example, Harden, Burke, Haile, and Estabrooks explored the degree to which specific interventions, identified within a systematic review, align in ways that facilitate translation of research into practice.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics Tools that Promote and Facilitate Knowledge Generation of Evidence

1. Overview
   - **a.** With approximately 80% of Americans now having regular Internet access evidence is often sought through Web-based resources
     - **(1)** Nurses help themselves, their students, patients, professional nursing groups, and their clinical team understand whether the information commonly downloaded about a specific condition or disease is accurate (valid and reliable) while pointing out potential benefits and harms
     - **(2)** Caution may be needed if information is being used without critical review
     - **(3)** A nurse can generate (and regularly update) lists of credible online evidence-based resources to suggest to patients, families, and other providers
     - **(4)** Because evidence becomes outdated, nurses can monitor to be sure that their teams and patients have current information, including understanding any legal and ethical concerns or privacy issues
   - **b.** Criteria to evaluate health-related information found online has been developed and disseminated by several organizations including HON Code, American Medical Association, Internet Healthcare Coalition, Hi-Ethics, and MedCertain
     - **(1)** However, criteria developed by these groups vary in scope and scale and have not been shared in a systematic way
     - **(2)** In addition, most of these criteria were designed for evaluating health and medical information, not necessarily nursing
   - **c.** Youth, young adults, and increasingly the rest of us are using mobile and portable devices, including tablets, portable computers, and smartphones to seek the evidence and engage with actual automated interventions (such as online counseling)
     - **(1)** Web-based screening, prevention, outreach, and intervention tools help patients to access valid and reliable evidence about fundamental public health issues, such as obesity, stress management, and tobacco cessation, while also helping patients track, reinforce, and manage healthy choices and gain online support
   - **d.** E-mail, evidence, and twitter alert systems involve voluntary registration based on clinical interest in order to receive alerts or updates related to interventions
     - **(1)** They are ideal for receiving information about new evidence or to send alerts about a safety concern, such as spreading information that a medication has been found dangerous
     - **(2)** Alerts are often linked to resources that allow access to the scientific literature matched to a specific clinical interest
     - **(3)** Alerts also deliver information that has already been rated
     - **(4)** However, the credibility of the informant often needs to be appraised
   - **e.** Assessments and interventions provided via a technology platform may occur without a provider
     - **(1)** Some of these tools allow for tracking and feedback about the patient's use of the tool to a nurse or other clinician
     - **(2)** Some of these tools are interactive and Web-based or may be run from a DVD, local computer, or flash-drive
     - **(3)** Mobile tools, such as phones and tablets, are also used
     - **(4)** Nurses help by addressing what is lost (in terms of nonverbal interactions, cues, and physical assistance) versus what is gained (through access and convenience) when a technology-based intervention works with other non-nursing clinicians
     - **(5)** Nurses can then tailor these tools to the needs of specific patients

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Models and Theoretical Frameworks Connecting Critical Thinking to Processes that Support the use of Evidence in Nursing Practice

1. Overview
   - **a.** Models and frameworks help link critical thinking to stepwise processes that promote the use of evidence, including accounting for factors that lead to safe and lasting outcome and organizational improvements
     - **(1)** Because translation involves implementing evidence and evidence-based tools outside tightly controlled situations, such as Randomized Controlled Trials (RCT), theories help nurses critically examine the contextual factors, assumptions, and influences surrounding implementation
     - **(2)** Using models and frameworks helps nurses prepare a cogent plan for translation within complicated situations, such as the implementation of an EBP when change and disruption are anticipated
     - **(3)** Nursing leaders across countries have contributed to theories about translation and quality improvement
     - **(4)** These theories include Donabedian's structure, process, and outcomes framework, which focus on problem solving
     - **(5)** Other theories directly relevant to translation are found in
       - **i.** Rogers' Diffusion of Innovations model
       - **ii.** The Funk Model
       - **iii.** The PRECEDE Model
       - **iv.** The Chronic Care Model

- **v.** The PARiHS Model
- **vi.** The Stetler Model
- **vii.** The Iowa Model and Translation Research Model
- **viii.** Russworm's and Larrabee's Model
- **ix.** The ARCC Model
- **x.** Kitson's Framework
- **xi.** Melnyk and Fineout-Overholt's Model of EBP
- **xii.** The Lean Framework
- **xiii.** The PICOT Model
- **xiv.** The QUERI model
- **xv.** Rossworm and Larrabee's Model
- **xvi.** The Institute for Healthcare Improvement's breakthrough model

(6) Some of these models are briefly described below

b. Exploring how nurses conceptualize translation helps nurses learn from each other

- **(1)** Specific contributions include Roger's understanding of "attributes" (including complexity) and Alison Kitson's emphasis on understanding the environment, including the importance of a clearly articulated collaborative Knowledge Translation (KT) approach that can be embedded into the research design
- **(2)** The Promoting Action on Research Implementation in Health Services (PARIHS) framework helps define and measure key factors leading to successful implementation and has been widely used, including by Squires et al. who designed strategies to implement research-based policies and procedures
- **(3)** Dr. Marita Titler provided leadership for AHRQ's TRIP initiatives and has also studied the context in which EBPs are translated
- **(4)** Important influences found include
  - **i.** The nature of the innovation (such as the strength of evidence)
  - **ii.** The manner it is communicated to nurses and physicians
- **(5)** Dr. Carole Estabrooks described the importance of considering the significant needs found in complex care environments, such as nursing homes
- **(6)** Dr. Cheryl Stetler evolved her practitioner-oriented Stetler Model of Evidence-Based Practice in ways that have shaped the evolution of EBP and also synthesized literature on use of the PARIHS framework, including development of a companion guide to assist researchers using PARIHS
- **(7)** The PARIHS framework is widely used internationally
- **(8)** Bergstrom, Peterson, Namusoko, Waiswa, and Wallin used PARIHS as a framework for knowledge translation in Uganda

c. As new technologies combine with novel approaches to measuring the complex factors affecting outcomes, theories and frameworks are being customized, including tailoring them to the workflow of nurses and the needs of developing nations

- **(1)** Melnyk and Fineout-Overholt adopted EBP competencies for nurses and advanced practice nurses (APNs) working in real-world clinical situations
- **(2)** Rycroft-Malone et al. and McCormack et al. described a new approach known as realist review and synthesis, which focuses on understanding the mechanisms by which an intervention works or does not work
- **(3)** Hynes et al. used the QUERI model to demonstrate how HIT approaches could be characterized as facilitators or barriers to implementation
- **(4)** Three pathways were found to contribute to translation:
  - **i.** Compliance and collaboration with information technology policies and procedures
  - **ii.** Operating within organizational policies and building collaborations with end users, clinicians, and administrators
  - **iii.** Obtaining and maintaining research resources and approvals
- **(5)** Harrison et al. emphasized the importance of planning support in development of a framework called CAN-IMPLEMENT
- **(6)** In Canada, The Queen's University Research Roadmap for Knowledge Implementation (QuRKI) is being used to highlight mutually supporting/interconnected cycles of research studies supporting implementation
- **(7)** In Australia, multidisciplinary Health Networks were used as a framework to collaboratively develop evidence-based policies and drive implementation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics Tools that Promote the use of Evidence and Apply Knowledge to Practice

1. Overview

a. Adoption of evidence is now understood far beyond passively providing access to a single clinical practice guideline or Webinar

- **(1)** The attention has shifted to understanding the conditions that foster ongoing and lasting change once the evidence is found and introduced, often using multiple implementation strategies
- **(2)** Increasingly, not only is the intervention being tested based on the best available evidence but the implementation strategies being used to apply the evidence are also grounded in science
- **(3)** Boulet, Bourbeau, Skomro, and Gupta authored one of many studies focusing on the complex barriers that cross the patient, provider, and healthcare system boundaries and suggested innovative, multifaceted approaches to implementation

Teaching Tip
Such studies provide local evidence about what will hopefully work when an EBP is translated. What will facilitate implementation and what will be the barriers? Under what conditions is successful implementation anticipated?

- (4) Young et al. demonstrated how complicated such investigations can become
- (5) Although home telehealth programs can be tailored to facilitate older adults' access to care, collecting data was challenging during this study because the patients did not want to be critical
- (6) But sustained improvement depended on understanding patient perspectives about the benefits and challenges of care coordination and home telehealth
- (7) Ultimately, it was documented that patients were frustrated by equipment problems, as well as slow response, and care coordinator inaccessibility
- (8) Understanding the influence of patient perceptions assured that expectations could be met. This facilitated translation

b. The information explosion presents challenges to healthcare providers who seek new evidence on an ongoing basis

- **(1)** Evidence-based clinical or point-of-care resources, especially literature reviews, make it easier to access information
- **(2)** Easy access helps nurses avoid making decisions based on experience alone or on the advice of a colleague or teacher
- **(3)** Evidence-based tools help by organizing evidence and aiding cognition in evidence selection, interpretation, implementation, and evaluation
- **(4)** When coupled with technology, evidence-based tools become central to practice
- **(5)** Yet this occurs within a climate of constant change and new incentives

Teaching Tip

Although rapid advances in access, quality, and safety are possible, nurses are challenged to create, find, test, implement, and evaluate the right evidence-based tools. Such tools include complex technology new to some nurses, including innovative decision support using mobile health-based approaches.

c. Decision support includes integrating experience with the evidence

- **(1)** Evidence-based tools are not "cookbooks"
- **(2)** When implementing a clinical intervention using an automated evidence-based tool, clinical judgment is needed
- **(3)** Because translation and decision support overlap, each is inherently multidisciplinary
- **(4)** Nursing joins public health, medicine, and other health disciplines in seeking better understanding of the conditions needed to successfully apply evidence to decision support in real situations, then measure the impact and feed data back after evaluation
- **(5)** As evidence brokers, computer-literate nurses bring to their teams knowledge of how to identify and then critically appraise the best available evidence or use the evidence-based tool(s) to support decisions
- **(6)** This includes knowing how to explain evidence to clinicians, families, and teams with varying degrees of scientific expertise and computer literacy
- **(7)** Explaining evidence includes understanding the "unintended consequences" that accompany translation and dealing with uncertainty when evidence is incomplete, misleading, or contradictory

Teaching Tip

For example, what happens when an automated clinical practice guideline recommends treatment for a specific clinical condition, such as cancer, but does not address priorities or contraindications with coexisting diagnoses, such as diabetes? Even the best evidence-based tool rarely applies to all patients without being tailored to subgroups or accounting for the patients' preferences. For some patients or subgroups, multiple evidence-based tools may need to be translated at the same time or specific interventions from different evidence-based tools tried together. Models help nurses create a cogent plan that pulls these interventions together.

d. Decision support now occurs within the context of change

- **(1)** Fueled by healthcare reform, HIT supports EBP by making it easier to access and use evidence and evidence-based tools, such as automated reminders
- **(2)** The US Center for Medicaid and Medicare Services (CMS) defines the "meaningful use" provision in the Affordable Care Act (ACA) legislation in ways that promote the use of evidence to drive improved outcomes, quality, and safety
- **(3)** The implications and pace are staggering
- **(4)** Within this environment, there are incentives that promote automated systems facilitating advances in HIT
- **(5)** Such advances promote EBP but also reveal gaps in quality and safety as well as disparities
- **(6)** Carefully planned use of HIT contributes to new and restructured systems that address the overuse, under use, and misuse of healthcare
- **(7)** Understanding the context in which HIT and EBP merge means studying what works and does not work during translation
- **(8)** This sometimes means feeding data back as the intervention is being implemented using methods such as formative evaluation
- **(9)** Although nurses are in the early stages of investigating factors associated with organizational context, such as explaining variation in the use of HIT during translation, there are a growing number of studies seeking to understand what makes a difference

Teaching Tip

For example, Currie, Lockett, and El Enany studied policy influences on those translating evidence into practice, including factors related to social position.

2. The use of Electronic Health Records (EHRs)

a. Automated tools are often linked to computerized health records, such as EHRs, which refer to patient records collected across settings, ideally to support care along the continuum of an individual's lifespan

   (1) As a result of the proliferation of electronic health data, clinical intelligence and other uses of aggregated data promote the conversion of meaningful information into knowledge
   (2) EHRs can be especially powerful if the data is standardized and copied into data warehouses or datamarts where data can be easily exchanged for follow-up purposes
b. Because EHR promotes meaningful use of technology and enhances information exchange, it plays a growing role in the translation of evidence into practice
   (1) EHR provides a vehicle to transmit evidence by embedding evidence-based tools into routine nursing functions
   (2) In doing so, EHR impacts quality and safety, hopefully in positive ways

Teaching Tip
For example, when EHR observations relevant to the implementation of a clinical practice guideline are pooled and analyzed, the data can then be shared, aggregated, and interpreted in ways that promote quality and safety.

   (3) Later, these data may become part of the body of evidence used to update the next version of a clinical practice guideline
   (4) Poe, Abbott, and Pronovost used peer coaches to build and sustain competencies needed by nurses using EHR in clinical settings
   (5) Both satisfaction and confidence increased through the use of an evidence-based coach intervention
   (6) Nurses are cautioned, however, to actively participate in the development, monitoring, implementation, and use of their EHRs
   (7) Ongoing diligence is needed to assure the timeliness of updates, the accuracy of input, as well as the usefulness and safety of output

3. Applying evidence in informatics to improve safety and quality of care

a. Nurses seeking to improve the safety and quality of care within their organizations can often find literature reviews, systematic reviews, meta-analyses, or evidence-based tools that address their specific goals or are relevant to their areas of practice
   (1) Technology-based tools can be used within an organization in ways that make it easier and faster to implement evidence-based tools while also making it harder to harm a patient
   (2) Evidence-based tools such as electronically available clinical practice guidelines, clinical decision support, automated performance measures, and computerized reminders, can be embedded into routines of care with feedback provided “just in time” to impact processes, intermediate outcomes, outcomes, and sometimes influence costs, patient and provider satisfaction, and even workforce issues

Teaching Tip
Electronic tools used to promote quality and safety offer a promising approach, for example, by aggregating patients who might benefit from being screened for an intervention or identifying which patients are at risk of a medication or other error.

   (3) The impact of electronic tools like these needs to be carefully evaluated prior to, during, and after implementation
   (4) Such evaluations may reveal characteristics of the organization and staff that will promote lasting use of an evidence-based tool
b. A dynamic high-functioning quality and safety culture requires that nurses continually examine the conditions needed to foster ongoing learning
   (1) It is important that data resulting from quality and performance measures not be used to punitively punish providers when targets or goals are not reached
   (2) Ongoing improvements in performance, quality, and safety based on the best available evidence are aided through evidence-based tools combined with an open environment where the cause of errors or poor performance can be explored outside a climate of fear
   (3) Performance, quality, and safety does not come through the technology alone but is influenced by those who implement, monitor, and use the technology
   (4) Innovation and progress are impeded by fear
   (5) The tools associated with implementing bar-coded patient wrist bracelets that match automated records to prevent patients from receiving the wrong medication or surveillance systems designed to detect healthcare-acquired infections are only useful when safely implemented and maintained
   (6) It is difficult to build a performance-driven culture when fear of reprisal is the norm

Teaching Tip
For example, automated quality and safety tools used within operating rooms can reduce the risk of reading an X-ray backwards, losing count of sponges and instruments, or operating on the wrong patient or the wrong side. This occurs systematically once local evidence about what works and does not work can be used to understand the complex factors that influence translation.

   (7) Although this can seem overwhelming, simulation and similar tools increasingly are used to help understand and prepare nurses for complex procedures, especially when the margin for error is small and options for training are limited

4. Evidence embedded into Clinical Decision Support (CDS) tools

a. Evidence is often embedded in CDS tools
   (1) *CDS captures the* processes used to enhance health-related decisions and actions with pertinent, organized

clinical knowledge and patient information, to improve health and healthcare delivery

   (2) CDS comes in many forms and interactive automated programs that assist clinicians with decisions, usually at the point-of-care

   (3) Decision analysis and CDS tie the probability of a specific clinical option to the likely results

   (4) The probability of alternative strategies can then be quantified

   (5) Many decision support tools are part of an EHR and promote the timeliness of a diagnosis or treatment intervention

   (6) CDS includes automated templates for orders and referrals that link to reminders or other forms of evidence

b. Computerized pathways, flow charts, algorithms, and critical paths are CDS tools that facilitate implementation in ways that reduce errors and promote compliance

   (1) Checks and triggers are embedded to guide clinicians through diagnostic and treatment interventions based on guideline recommendations

   (2) Algorithm-based decision systems can be used, for example, to prompt clinicians about the correct interval for a laboratory test

c. Automated reminders are a form of decision support used in "real time" or at the point of patient contact

Teaching Tip
For example, an automated system can analyze a patient's age and risk factors to generate a screen or audible reminder when an evidence-based intervention is appropriate but not performed.

5. Evidence integrated into care coordination and continuum of care mapping

a. Case management and care coordination are key roles for nurses who follow a panel of patients, including assuring that evidence-based diagnostic and treatment interventions are completed

   (1) Communication and information sharing are promoted electronically across providers throughout the flow of their work so that the patient benefits from coordinated care

6. Cognitive aids (clinical business intelligence, automated GIS, big data, visual analytics, clinical analytics) and advanced informatics to support evidence in practice

a. Cognitive aids help nurses use data and link it to evidence by expanding the ability to quickly process, compare, and interpret large volumes of complex data

   (1) Automated tools that help make sense of the growing abundance of structured and unstructured data are growing in popularity and availability, and are sometimes now used at the point-of-care

   (2) These tools can be used to retrospectively look back using data to support performance measurement or to support population health

   (3) Cognitive aids can also be used prospectively by aggregating the data then using it to predict and offer guidance for future care

b. Pathways can be developed to foster variance analysis, which compares patients to a group using aggregated data

   (1) Geographic Information Systems or Geographic Information Science (GIS) refers to Web sites or services that connect data from different sources in order to share, remix, repurpose, and reconnect them

c. Clinical and Business Intelligence takes data from large healthcare databases in order to analyze and feed it back in ways that aid interpretation and inform decisions

   (1) Visualization of multiple data sets can be integrated using a common format that enhances how much information is needed to support a decision

   (2) Such tools are transformative in their ability to interactively engage nurses and patients as they combine data with experience as well as generate new hypotheses

7. Trigger tools, bundles, and rapid cycle testing

a. The Institute for Healthcare Improvement (IHI) and other groups use many different automated tools that often work in tandem with quality and safety efforts

   (1) "Triggers" measure harm through retrospective review of records using clues about adverse events

   (2) A bundle is a group of three to five evidence-based practices linked together

   (3) A bundle is used to promote adoption of specific interventions. Impact can then be measured and the data fed back

8. Automated performance measures

a. Quality and safety measurement is an efficient way to promote the use of evidence and move it quickly into practice

   (1) Clinical quality measures as well as performance measures related to quality and safety quantify differences in the care provided to individuals, organizations, plans, facilities, or networks

   (2) Performance measures and indicators are often based on clinical practice guidelines or other synthesized (credible) evidence

b. A performance measure or indicator is derived using administrative or clinical data, often pulled from automated records

Teaching Tip
An example of an electronic measure (using an EHR) is the number of patients who appropriately received antibiotics for pneumonia within four hours of arriving at a care setting. The numerator is the number who received the intervention (antibiotics) divided by the total number of patients eligible (patients who should have received them).

   (1) Such measurement assesses provider and organizational performance, which is then available for benchmarking, quality improvement efforts, and financial decisions

(2) Patient safety indicators (PSI) use abstracted administrative data to help providers identify risks

Teaching Tip
For example, when patients unexpectedly die or are identified after readmission (when not expected to be readmitted) within 30 days of discharge, patient safety tools, including Root Cause Analysis, can be used to understand and correct errors.

(3) Robust performance measures increasingly are developed, tested, and introduced, including composite (combined) and "tightly linked" measures for specific conditions. Poorly constructed measures can lead to bias or "gaming"

9. **Emerging technologies and trends**
   - **a.** Clinical analytics (previously described) holds exciting promise for advancing quality and safety, for example, when coupled with Lean, Six Sigma, or a similar framework
     - **(1)** Using clinical analytics, high degrees of variation in outcomes can be identified at an early point that may promote prevention, safety, and clinical improvements
     - **(2)** Automated tools used for EBP are evolving quickly
     - **(3)** Nurses lead by implementing and evaluating these tools, especially new ones, during translation activities

Teaching Tip
For example, "ubicom" (also called ubicomp or pervasive computing) uses ambient intelligence (an intelligent environment) to embed human interactions into routine practices or activities. Sensors may be worn to unobtrusively collect cardiac data. As ambient intelligence becomes more common, nurses can measure and report not only the effectiveness of the tool itself but also the effectiveness of the implementation strategies used to apply the evidence. These reports and studies will help nurses address the implications for education, risk, compliance, and teamwork when new technologies appear.

10. **Human communication principles still apply**
   - **a.** Evidence is translated at the level understood by each patient and by the providers in a clinical team
     - **(1)** When applying evidence, many factors associated with patients (and their families), as well as other providers, require attention, including culture and literacy

Teaching Tip
Consider the different approaches to diabetes education that might be needed when teaching a patient who routinely uses technology to talk, transmit, and text versus another patient who rarely (or never) sees a computer. Age, language, exposure, and comfort with technology often need to be considered before discussions about evidence and care can even begin with a patient.

- **(2)** HIT interface designs need to support patient–clinician interactions and relationships
- **(3)** As patients increasingly bring their own information into healthcare decisions and articulate their preferences, the skills needed to foster the best possible choices expand
- **(4)** Fuelled by technology, expectations are changing
- **(5)** Patients and families often facilitate use of evidence by challenging their providers to explain the options for care
- **(6)** Rather than push technology onto patients, it may help to observe what the patient understands about their own documentation and work with the patient as a partner in adapting newer technologies
- **(7)** Communication about why a specific test of intervention is being suggested requires explaining the evidence
- **(8)** E-mail, texting, and other electronic media can facilitate such communication
- **(9)** Automated training materials can also be conveniently provided at a reasonable cost, either by sending materials electronically or providing them at the point-of-care
- **(10)** Patients may ask a nurse about evidence that does not exist
- **(11)** Even when the evidence is strong, the factors related to its use in real settings are often limited

Teaching Tip
For example, it can be challenging when patients ask about what others with their same diagnosis choose or want to talk about costs or the trade-offs associated with their own personal values. Patient preferences are especially relevant when the condition is chronic and non-life-threatening, such as cataract extraction. In these instances, the patient's preferences become the focus of the decision.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Professional Nursing Groups and Networks that Provide Resources to Translate Evidence into Nursing Practice

1. Overview
   - **a.** Nursing groups and networks help expand and improve resources by creating, promoting, and assisting expansion of the knowledge base surrounding EBP
     - **(1)** Key groups include
       - **i.** The Office of the National Coordinator for Health Information Technology (ONC)
       - **ii.** Healthcare Information and Management Systems Society (HIMSS)
       - **iii.** The Alliance for Nursing Informatics (ANI)
       - **iv.** The American Medical Informatics Association (AMIA)

- **v.** The American Nursing Informatics Association (ANIA)
- **vi.** ANIA's sister organization, The Capital Area Roundtable on Informatics in Nursing (CARING)

(2) The US Agency for Healthcare Research and Quality also provides a wide array of resources, including

- **i.** Interactive tools for patients
- **ii.** The US Health Information Knowledge base—which is a metadata registry of data standards, and results from their Knowledge Transfer and Translating Research Into Practice (TRIP I and TRIP II) programs

(3) Sigma Theta Tau International sponsors conferences, research, and resources to support evidence-based information and implementation and translation into practice

(4) Sigma Theta Tau International sponsors a scholarly journal entitled: *Worldviews on Evidence-Based Nursing*

(5) International Evidence Dissemination through the Cochrane Collaboration and Joanna Briggs Institute

b. There is a growing list of notable international nursing, health services, and informatics groups that contribute to our knowledge based about EBP, including The Cochrane Collaboration, which hosts a library of evidence reviews, and The Knowledge Translation+ (KT+) resources provided by McMaster University's Health Information Research Unit

(1) KT+ exemplifies the proliferating resources available to nurses seeking peer-reviewed articles, systematic reviews relevant to safety and quality improvement, professional education, automated clinical decision support, and patient resources

(2) The Cochrane Collaboration includes a Nursing Care Field (CNCF) since so many nurses use the evidence available in nursing

(3) One of the nursing collaborators within the CNCF is the Joanna Briggs Institute

(4) Within Nursing the Joanna Briggs collaborative includes over 70 entities globally to also engage in the development, dissemination, implementation, and translation of evidence to improve care to patients delivered by nurses

(5) In the United States, Joanna Briggs Collaborative Centers are located in Indiana, Louisiana, New Jersey, Oklahoma, Texas, and California

(6) Canadian collaborative centers are in Ontario, Canada

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

How Professional Nurses Might Engage in Advancing Evidence, Informatics Tools, Integration and Translation into Practice

1. Overview

a. Nurses lead in a number of important ways related to the use of technology in translation. Ideas for next steps as nursing moves forward include the need for nurses to

(1) Promote evidence-driven care aided by theories, such as QuRKI, that help find solutions amidst the interconnected cycles of research and translation. The Queen's Roadmap within QuRKI is one of the useful approaches nurses can use, study, and report about as they systematically improve quality and safety. Such roadmaps are useful in addressing the complexity associated with translation. As QuRKI and other approaches are used, nurses can share what they learn about the context in which the evidence is used. This attention to context helps nurses identify and manage the facilitators and barriers needed to translate a clinical practice guideline recommendation or other external evidence

Teaching Tip
For example, nurses can more easily learn how to form strategic and collaborative relationships that naturally foster evidence-informed implementation and facilitate sustained buy-in.

(2) Clearly describe the choices and rationale surrounding implementation strategies. This rationale links the choice of implementation strategies to determinants of change and helps draw meaningful interpretations. Create research–practice alliances and other collaborative relationships to use information about the local context in ways that help identify "best practices" that foster change

(3) Explicitly address the limitations surrounding translation efforts, such as difficulty in generalizing findings, the need for more advanced methods, little information about costs, and the complexity of measuring disparities and involving patients

(4) Explicitly address the limitations surrounding technology applied to healthcare, such as automating poor quality interventions that are not grounded in the best available evidence. Implementing the wrong information can easily lead to faulty automated processes that waste resources, cause frustration, and potentially harm patients

(5) Pursue conceptual clarity such that meaningful evaluations and comparisons are possible. This may include use of existing classifications

(6) Identify security and privacy risks and help patients and others to address them

(7) Collaborate across education, administration, clinical care, research, and policy boundaries to standardize terminology and expand the knowledge base about effective solutions to complex healthcare problems. Nurses can foster teamwork across silos in ways that address inconsistencies in terms such as "clinical significance." Many of the definitions relevant to EBP change over time and can be hard to measure. Nurses can help define and standardize key definitions while promoting consensus about how to measure a patient's response to an intervention in ways that adhere to evidence-based standards or "best practices"

(8) Define clear goals for translation that capture the complex factors influencing nurses as they strive to apply evidence in real situations

(9) Define methodological issues. For each one, explicitly define the state of the science, study design, and measurement complexities in ways that advance translational research

(10) Build the skills needed to discuss evidence with patients who are computer literate as well as those who do not use technology to access research findings and use them as the basis for their questions

(11) Promote the inclusion and active participation of nurses as part of the multidisciplinary teams that synthesize research findings and translate evidence into evidence-based tools

(12) Participate in the peer review of evidence-based tools and other expert review and feedback

(13) Educate teams and organizations that performance and quality measurement are useful and valuable but can also be harmful. Negative results (such as not reaching a target) can be used to improve care and reduce risks but should only lead to punitive action when serious issues, such as patient safety, reveal risk

(14) Explicitly address the risk of bias or other threats to the integrity of evidence-based tools. Conflicts of interest are possible at any point, including the selection of "experts" who rate the evidence or those who choose the recommendations to translate. Caution is needed so that bias does not lead to underestimating potential risk, ignoring resource or costs (unless they are intentionally ignored), or promoting overtreatment

(15) Promote active dialog within clinical teams and with patients to address recommendations that lack conclusive net weight of benefits and harms

(16) Provide input from the beginning in the design and implementation of HIT projects and offer caution that HIT can both help and harm patients

(17) Support patients to access accurate evidence by helping them use online tools believed to contribute to positive outcomes, such as an automated self-check-in tool that encourages patients to tailor their behavior to their goal as they pursue change. The nurse may want to practice with the patient to help set up the automated messaging systems that accompany some tools

(18) Provide expert advice or monitoring of text-based communication through e-mail, social media, listservs, networks, forums, or a mobile format. While online groups and chat rooms offer convenience, they also sometimes lead to exchange of misinformation. Nurses can help by monitoring or serving as a resource

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Summary

- Because the findings from an individual peer-reviewed publication rarely make their way into the accepted standards of nursing care, few also lead directly to improved outcomes
- But evidence synthesis combined with enabling technologies are transformative
- Nurses help the profession as well as patients, teams, and professional groups by identifying literature reviews, meta-analyses, and evidence-based tools that are ready for translation and a good fit for a specific patient group and setting
- These tools are used at the intersection of technology and translation, where nurses reduce both the time it takes to bring evidence into practice as well as unexplained variation
- The nurse accomplishes this in exciting new ways, including by combining CDS, clinical informatics, and other evidence-based tools that promote use of clinical protocols, including Meaningful Use Core Measures
- Graphical displays at integrated workstations help track patients and prioritize care
- The Queen's Roadmap (QuRKI) offers one approach that nurses can use as they systematically plan translation in ways that take into account complex factors that influence success
- As nurses bring this vision into focus, HIT advances will no longer outpace the profession's ability to move evidence into practice and outcomes will improve

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Understand translational science and closely related terminology
- Identify tools supporting the translation of evidence at the data, information, knowledge, and wisdom meta-structure levels
- Describe the evolution of evidence-based practice and evolving trends in the translation of evidence into practice
- Describe how informatics is used as a tool to promote and facilitate knowledge generation and translation in practice
- Describe models and frameworks connecting critical thinking to processes that support the use of evidence into nursing practice
- Discuss how informatics tools serve to promote use of evidence and the application of knowledge in practice
- Identify professional nursing groups and networks that help expand and improve resources to assist in translating evidence into nursing practice
- Discuss how professional nurses might engage in advancing the next steps and how informatics tools can be used to deliver evidence into nursing practice

Teaching Tip

Ask the students to define the keywords

- Evidence
- Knowledge generation
- Clinical practice guidelines
- Evidence-based practice tools
- Meaningful use
- Performance metrics
- Quality and safety of patient care

CHAPTER REVIEW QUESTIONS

Question 39.1: What IT methods facilitate communication between individuals beyond face-to-face communication?

a. E-mail, texting, and other electronic media can facilitate such communication
b. Complex design analysis of long- and short-term strategies
c. Calling, texting, and hollering to the next room
d. Computer-assisted decision supports that embed the directions for diagnosis and treatment option

Question 39.2: What two measures can quantify differences in the care provided to individuals, organizations, plans, facilities, or networks?

a. eMeasures and Clinical Practice Guidelines
b. Performance metrics and eMeasures
c. Patient safety indicators and risk assessment factors
d. Clinical quality measures as well as performance measures related to quality and safety quantify differences in the care provided to individuals, organizations, plans, facilities, or networks

Question 39.3: What are two tools to transform data to information?

a. Decision support and evidence-based guidelines
b. Benchmarking and outcome assessment
c. Data warehouses and clinical dashboards
d. Imaging and data representation

Question 39.4: Four meta-structure levels in translating evidence into practice are ________?

a. Data, information, knowledge, wisdom
b. Data, infrastructure, computerization, and costs
c. Cost, quality, effectiveness, and efficiency
d. None of the above

Question 39.5: A practice-based evidence score of "A" would indicate what?

a. The practice should be abandoned
b. Offer or provide the service
c. Discourage the use of the service
d. a, b, and c

Question 39.6: What are four tools to improve safety and quality of care?

a. Literature reviews, systematic reviews, meta-analyses, or evidence-based tools can address their specific goals for improving safety and quality
b. Computers, mobile devices, systematic reviews, and continuing education can address their specific goals for improving safety and quality
c. Computerized decision supports, performance measures, business intelligence, and risk assessments can address their specific goals for improving safety and quality
d. Journal clubs, social media networks, texting, and attending conferences can address their specific goals for improving safety and quality

Question 39.7: In what ways can the nurse bring the tools of evidence translated into practice?

a. There are no ways the nurse can bring the tools of evidence to be translated into practice
b. The nurse has to conduct research in health services research to translate evidence into practice
c. The nurse accomplishes translation into practice in exciting new ways, including by combining CDS, clinical informatics, and other evidence-based tools that promote use of clinical protocols, including Meaningful Use Core Measures
d. None of the above

Question 39.8: What is the name of the Canadian roadmap that offers an approach to systematically translate evidence into practice?

a. The Queen's Roadmap (QuRKI) offers one approach that nurses can use as they systematically plan translation in ways that take into account complex factors that influence success
b. The Queen's Roadmap to Evaluate Research into Practice (QRERP) is an approach to translate evidence into practice
c. The Queen's Roadmap to Research Implementation (QuRI) is an approach to translate evidence into practice
d. None of the above

Question 39.9: Name key nursing professional organizations that help expand and improve resources by creating, promoting, and assisting expansion of the knowledge base surrounding EBP.

a. Key groups include the NLM, AHRQ, CMS, and ONC
b. Key groups include The Office of the National Coordinator for Health Information Technology (ONC), Healthcare Information and Management Systems Society (HIMSS), The Alliance for Nursing Informatics (ANI), The American Medical Informatics Association (AMIA), The American Nursing Informatics Association (ANIA), and ANIA's sister organization, The Capital Area Roundtable on Informatics in Nursing (CARING)
c. Key groups include the QRERP, QuRI, and QuRKI
d. None of the above

Question 39.10: Name some of the models to translate evidence into nursing practice.

- **a.** Some models to translate evidence into nursing practice include: the Funk Model, the PRECEDE Model, the Chronic Care Model, the PARiHS Model, and the Stetler Model
- **b.** Some models to translate evidence into nursing practice include: the Iowa Model and Translation Research Model, Russworm's and Larrabee's Model, the ARCC Model, Kitson's Framework, and Melnyk and Fineout-Overholt's Model of EBP
- **c.** Some models to translate evidence into nursing practice include: the Lean Framework, the PICOT Model, the QUERI model, Rossworm and Larrabee's Model, and the Institute for Healthcare Improvement's breakthrough model
- **d.** All of the above

ANSWERS AND EXPLANATIONS

Question 39.1: (a) E-mail, texting, and other electronic media can facilitate such communication.

Question 39.2: (d) Clinical quality measures as well as performance measures related to quality and safety quantify differences in the care provided to individuals, organizations, plans, facilities, or networks.

Question 39.3: (d) Imaging and data representation.

Question 39.4: (a) Data, information, knowledge, and wisdom.

Question 39.5: (b) Offer or provide the service.

Question 39.6: (a) Nurses seeking to improve the safety and quality of care within their organizations can often find literature reviews, systematic reviews, meta-analyses, or evidence-based tools that address their specific goals or are relevant to their areas of practice (Tricco, 2012).

Question 39.7: (c) The nurse accomplishes translation into practice in exciting new ways, including by combining CDS, clinical informatics, and other evidence-based tools that promote use of clinical protocols, including Meaningful Use Core Measures.

Question 39.8: (a) The Queen's Roadmap (QuRKI) offers one approach that nurses can use as they systematically plan translation in ways that take into account complex factors that influence success.

Question 39.9: (b) Key nursing professional organization groups include The Office of the National Coordinator for Health Information Technology (ONC), Healthcare Information and Management Systems Society (HIMSS), The Alliance for Nursing Informatics (ANI), The American Medical Informatics Association (AMIA), The American Nursing Informatics Association (ANIA), and ANIA's sister organization, The Capital Area Roundtable on Informatics in Nursing (CARING).

Question 39.10: (d) All of the above. Some models to translate evidence into nursing practice include: the Funk Model, the PRECEDE Model, the Chronic Care Model, the PARiHS Model, the Stetler Model, the Iowa Model and Translation Research Model, Russworm's and Larrabee's Model, the ARCC Model, Kitson's Framework, Melnyk and Fineout-Overholt's Model of EBP, the Lean Framework, the PICOT Model, the QUERI model, Rossworm and Larrabee's Model, and the Institute for Healthcare Improvement's breakthrough model.

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Improving Healthcare Quality and Patient Outcomes Through the Integration of Evidence-Based Practice and Informatics

• OBJECTIVES

1. Define evidence-based practice.
2. Discuss how evidence-based practice impacts healthcare quality, safety, and cost reduction.
3. Discuss barriers and facilitators for successful implementation of evidence-based practice in the clinical setting.
4. Discuss the evidence-based practice paradigm and process.
5. Identify technology tools in clinical practice which support evidence-based practice.
6. Discuss the role of clinical decision support systems in evidence-based practice.
7. Identify considerations for a successful clinical decision support system.
8. Discuss the integration of evidence-based practice in clinical areas.
9. Discuss a professional practice model which supports evidence-based practice.
10. Identify data types of standardized terminology.
11. Explain the differences between data, information, knowledge, and wisdom.
12. Discuss options available with vendors in support of evidence-based practice.
13. Identify regulatory and agency impacts on decision support.

• KEY WORDS

Evidence-based practice
Decision support
Clinical decision support
Evidence-based adaptive clinical decision support
PICOT
Data
Nursing informatics
Clinical terminology
Technology tools
Professional practice model
Quality measures

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions about the class, such as the following: What is the definition of quality? Can you give examples of quality? Why is quality important in healthcare? Why is quality in healthcare important to nurses? Can you define clinical decision support? Can you give examples of clinical decision support? Why should nurses be interested in clinical decision support? Explain and define data, information, knowledge, and wisdom. What are similarities and differences?

For a WIIFM statement, say to the class, "This chapter focuses on the role of evidence-based practice and the impact on healthcare quality, safety, and cost reduction. In addition, the chapter provides an introduction to the role of clinical decision support. In addition the chapter provides an overview to data, information, knowledge, and wisdom." As a nurse, it is important to understand evidence-based practice, be familiar with tools in clinical practices that support evidence-based practice as well as knowledge of clinical decision support.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Improving Healthcare Quality and Patient Outcomes Through the Integration of Evidence-Based Practice and Informatics

1. Introduction
    a. There is mounting evidence that implementation of evidence-based practice (EBP) by nurses and other health professionals results in higher quality healthcare, improved patient outcomes, less variation in care, and reduced costs compared with care that is steeped in tradition or based on outdated policies and practices
        (1) In addition, findings from studies have supported that when nurses believe in the value of EBP and are able to implement evidence-based care, they have higher job satisfaction and better group cohesion, which are key determinants of job turnover guide best practices
        (2) In contrast to research that generates new knowledge and evidence for practice, EBP translates evidence from research into clinical practice to improve healthcare quality and patient outcomes
        (3) Because of the known positive outcomes associated with EBP, the Institute of Medicine set a goal that 90% of healthcare decisions will be evidence-based by 2020
        (4) Despite its positive outcomes and recent mandates by leaders, professional organizations, and policy makers to base and reimburse care on the best and latest evidence, EBP is not consistently implemented by numerous healthcare systems and clinicians across the United States
    b. There is no doubt that the use of technology with clinical decision support systems can enhance the delivery of evidence-based care
        (1) However, technology must be used by clinicians who implement the steps of EBP and healthcare organizations that cultivate system-wide cultures of EBP if high-quality evidence-based care is to be sustained
    c. In 2000, Sackett and colleagues defined EBP as the conscientious use of current best evidence in making decisions about patient care
        (1) Since then, EBP has been broadened and described as a problem-solving approach to the delivery of care that integrates the best evidence from well-designed studies with a clinician's expertise and patient preferences and values in making clinical decisions (Melnyk & Fineout-Overholt, 2011)
        (2) Both external evidence (i.e., findings from research) and internal evidence (i.e., evidence that is generated from outcomes management or quality improvement projects) should be used in evidence-based decision making
        (3) When clinicians deliver EBP in a context of caring as well as an organizational culture and environment that support EBP, the highest quality of care and best patient outcomes are achieved
        (4) If healthcare systems are to be redesigned to improve the quality of care and patient outcomes as well as reduce costs, clinicians must translate internal and external evidence that is collected, analyzed, and critically appraised into useful information to guide best practices
2. The seven steps of EBP
    a. There are seven steps in the EBP process

Teaching Tip

See Table 40.1.

        (1) In the first step, which is Step 0, a spirit of inquiry in clinicians and a culture of EBP must be cultivated in order to stimulate the asking of burning clinical questions to improve patient care
        (2) Once a clinical question is generated, Step 1 in the EBP process involves formatting clinical questions into PICOT format (P = patient population, I = intervention or interest area, C = comparison intervention or group, O = outcome, and T = time)

(3) Formatting clinical questions in PICOT format is necessary to streamline the search for evidence to answer the question

Teaching Tip

An example of a PICOT question about a treatment is: In depressed adolescents (P), how does the delivery of cognitive behavior therapy in person (I) versus delivery of Web-based cognitive behavior therapy (C) affect depressive symptoms (O) three months after treatment (T).

b. In Step 2 of the EBP process, a search for the evidence is conducted by entering each key word from the PICOT question into the database that is being searched (e.g., Medline, CINHAL) and then combining the search words together to reveal the studies that may answer the question
  - **(1)** Reliable resources that should be used to find an answer to the PICOT question include systematic reviews, clinical practice guidelines, pre-appraised literature, and studies from peer-reviewed journals

c. In Step 3 of EBP, a rapid critical appraisal of the studies from the search is conducted, followed by an evaluation and synthesis of the research evidence

d. In Step 4, evidence is integrated with the clinician's expertise and patient preferences and values to make a decision regarding whether a practice change should be made
  - **(1)** Once a practice change is made based on the best evidence, outcomes should be measured to determine positive outcomes of the change (i.e., Step 5)
  - **(2)** Evaluation of outcomes is an essential step in EBP as it helps to determine if the EBP practice change was successful, effective, equitable, timely, and needs to be modified or discarded
  - **(3)** The last step in the EBP process, Step 6, is disseminating the outcome of the practice change through presentation or publication so that others can benefit from the process

3. Barriers and facilitators of EBP

a. There are multiple barriers to advancing EBP in healthcare systems, including
  - **(1)** Misperceptions by clinicians that it takes too much time
  - **(2)** Lack of EBP knowledge and skills
  - **(3)** Organizational cultures that do not support EBP
  - **(4)** Lack of resources, including clinical decision support tools
  - **(5)** Executive leaders and managers who do not model and/or support EBP
  - **(6)** Lack of EBP mentors to work with point-of-care staff on implementing evidence-based care
  - **(7)** Inadequate access to databases by clinicians in order to track patient and system outcomes
  - **(8)** Negative attitudes toward research

b. Findings from studies also have established key facilitators of EBP that include
  - **(1)** Strong beliefs about the value of EBP and the ability to implement it
  - **(2)** EBP knowledge and skills
  - **(3)** Organizational cultures that support EBP
  - **(4)** EBP mentors who have in-depth knowledge and skills in evidence-based care as well as individual and organizational change
  - **(5)** Administrative support
  - **(6)** Clinical promotion systems that incorporate EBP competencies
  - **(7)** EBP tools at the point-of-care, such as clinical decision support systems

4. Cultivating a culture that supports and sustains EBP

a. In order to cultivate a culture and environment that supports and sustains EBP, an organization must provide system-wide support for evidence-based care
  - **(1)** This support begins with a vision, philosophy, and mission that incorporate EBP as a key component, which are made visible to all throughout the organization
  - **(2)** High-level administration and nurse managers must not only "buy-in" to this vision, but also model EBP themselves as much of how clinicians perform is learned through observation of their key leaders and managers
  - **(3)** Integrating EBP and the newly created EBP competencies for registered nurses and advanced practice nurses throughout the clinical ladder system if one exists also establishes the importance of evidence-based care for staff advancement
  - **(4)** Furthermore, ample resources and supports must be provided to clinicians that enhance their ability to provide evidence-based care. Examples of resources and supports are identified

Teaching Tip

See Table 40.2.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Role of Technology in Supporting Evidence-Based Practice

1. Technology tools in clinical practice

a. Nurses, nurse practitioners, and healthcare providers today are very cognizant of the push for cost containment, improved patient safety, improved quality of care, and reduced variation in care throughout not only the United States but the world
  - **(1)** It is readily observed, there is a shift in healthcare choices being made based on quality and outcomes, not solely cost as reimbursement moves toward payments for quality

b. Information technology (IT) has brought to healthcare a compendium of new tools which support EBP
  - **(1)** As a consequence, IT has not only improved, but also complicated many currently existing processes

   - **(2)** A goal of informatics is to use technology to bring critical and essential information to the point-of-care to increase efficiency, make healthcare safer and more effective, and improve quality and outcomes
   - **(3)** Despite the advancement in IT, the most effective, evidence-based care remains evasive for nurses

2. Competencies

- **a.** Nursing professionals range in age from their early 20s to their 60s with the average age of a registered nurse today in their early 50s
   - **(1)** This range presents a significant range of learning skills and comfort with technology and EBP
   - **(2)** Nursing students today are very adept with using iPads, iPhones, laptops, and other technology devices
   - **(3)** They have been using them since childhood
   - **(4)** In 2006, a National League of Nursing (NLN) study revealed 60% of nursing programs had a computer literacy requirement and 40% had an information literacy requirement
   - **(5)** Less than 50% of the respondents stated informatics was integrated into the curriculum and experience with information systems provided during the clinical experiences
   - **(6)** As an outcome of the study the NLN published a position statement recommending nursing schools require all nursing students graduate with knowledge and skills in each of three critical areas: computer literacy, information literacy, and informatics
- **b.** Pravikoff, Tanner, and Pierce found that nurses use experientially acquired information from interactions with peers, patients, colleagues, and physicians greater than scientific evidence from medical and research journals
   - **(1)** This finding still exists today
   - **(2)** It is imperative for nurses today to have the skills required to engage in EBP
   - **(3)** Preparing undergraduate nursing students in EBP and the use of the proper technology has significance for advancing EBP in nursing
   - **(4)** Rush states, “the preparation of undergraduate nursing students for using evidence to guide practice is no longer optional. Evidence-based practice is imperative for ensuring quality, cost-effective safe care and more predictable outcomes for healthcare consumers”

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Decision Support and Evidence-Based Practice

1. Decision support systems

- **a.** *Decision support systems* (DSS) “are automated tools designed to support decision making activities and improve the decision-making process and decision outcomes
   - **(1)** Such systems are intended to use the enormous amounts of data that exist in information systems to facilitate decision processes”
- **b.** *Clinical decision support systems* (CDSS) are systems designed “to support healthcare providers in making decisions about the delivery and management of patient care”
   - **(1)** They have “the potential to improve the patient safety and outcomes for specific patient populations, as well as compliance with clinical guidelines and standards of practice and regulatory requirements”
- **c.** *Evidence-based adaptive clinical decision support systems* are systems designed with multiple rules and access to multiple databases for information
   - **(1)** They are complex systems and contain mechanisms to incorporate new findings and evidence

2. Standardization of terminology and data

- **a.** Clinical Terminologies are a factor which plays a significant role in increasing the availability of evidence at the point-of-care
   - **(1)** They have not matured to a level to be used in clinical information systems (CIS)
   - **(2)** Standardized clinical terminology is necessary for the evidence to be both computable and interoperable with multiple systems
   - **(3)** The next step is to facilitate EBP by increasing the transparency to the healthcare provider
- **b.** To be efficient, the evidence for EBP must be incorporated into the everyday workflows and care processes used by nurses and other healthcare providers
   - **(1)** The data must be integrated with the clinical systems used by the providers and provide readily accessible evidence-based knowledge for the end user at the point-of-care when needed
   - **(2)** To be successful it is essential to link evidence to assessments, results, documentation, orders, and plans of care
   - **(3)** Gugerty states, “It’s in these forms—plans of care, order sets, standardized rules and alerts, and the like—that evidence will finally be widely, consistently, and reliably used at the point of care”
- **c.** Standardized nursing terminology is required for quantifiable and retrievable data. It allows for documentation and coding of Nursing practice in the EHR
   - **(1)** IT systems document and code nursing practice, aggregate and compare coded data across client settings, populations, and time, and develop core databases for data mining and meta analysis
   - **(2)** Terminology is also required for compliance with regulatory and payer requirements

Teaching Tip
Examples of Nursing Classifications used today are listed in Table 40.3.

- **d.** What are the criteria for standardized nursing terminology?
   - **(1)** Cimino’s desiderata for the design of a controlled healthcare vocabulary included free, usable in all clinical settings, interoperable, atomic level concepts with unique codes and definitions, nonredundant and nonambiguous, domain completeness, uses open architecture, can

be quantified, designed for computer-based systems, developed empirically from research, and link nursing diagnosis to interventions and outcomes

e. *Identification of common data definitions*

(1) It is not uncommon for different departments, hospitals, and systems to have different definitions of the same data elements

(2) Unless everyone is using the same set of data definitions there will be errors in data collection, analysis, and conclusions

(3) This is one reason the Meaningful Use Core Measures and Quality Measures are explicitly defined for data collection and reporting

(4) Travers and Mandelkerhr identified seven aspects which should be considered for identification of common data definitions

Teaching Tip
See Table 40.4.

(5) Each of these is also essential for Meaningful Use Core Measures and Quality Measures

f. *Tools for managing clinical data*

(1) Tools can vary from Excel spreadsheets and Access databases to database programs

g. *Data quality*

(1) Inaccurate and incomplete data will impact the quality of the data upon which decisions will be made and impact quality

(2) Data end users should understand how the data they are using is defined

(3) Many computer programs contain features to prevent data entry errors by restricting the type of data which can be entered such as a date in numeric form or limiting the range

h. *System selection issues*

(1) Clinicians should participate in the selection process for CIS and consider data requirements during the selection process

(2) They should consider the quality and availability of the data for use on the back end to facilitate other uses of routinely collected health data such as benchmarking, quality improvement, research, and surveillance

(3) Vendors should be questioned as to the types of reports available, ability to customize reports and create ad hoc reports, and the ability to export data for use with other applications

(4) "Data consistency and completeness are critical to the scientific rigor or retrospective studies"

(5) "Underestimating the importance of data management can hinder data quality, impair research results, misinform clinical practice, or generate invalid hypotheses for new clinical trials"

3. Considerations for successful CDSS

a. Lee completed an extensive literature search to identify and organize the system features of decision support technologies targeted at nursing practice into assessment, problem identification, care plans, implementation, and outcomes

(1) Bryne and Lang examined nursing data elements from evidence-based recommendations for clinical decision support

(2) The analysis provided a description of the representation of data elements and issues related to the availability of data for use in the future development of clinical decision support systems to prevent ICU delirium

(3) They found the matched data elements were primarily text based, entered by RNs on flow sheets and care plan

(4) "Even though there was a high number of potential data element matches, there was considerable variable data availability related to clinical, conceptual, and technical factors. The further development of valid and reliable data that accurately capture the interaction between nurse, patient, and family is necessary before embarking on electronic clinical decision support"

(5) Bryne and Lang found the build of the CDSS could allow for multiple data sources to be analyzed, but that did not address the practical implications of redundancy, ambiguity, and lack of conceptual clarity identified in the data sources

(6) For their study, they provide three recommendations for the capture of nursing care in a standardized format to be used in CDSS support

(7) They were

i. Improve the electronic capture of nursing phenomena and care processes

ii. Promote the use and integration of standardized nursing terminologies such as ICNP and SNOMED-CT

iii. Capitalize on data elements with high data availability

b. Sittig identified five elements as prerequisites for a clinical real-time point-of-care clinical decision support system

(1) They include

i. Integrated, real-time patient database. The database must be able to integrate data under a common patient identified. It stores and updates all data as soon as results are available, forming the basis of any real-time CDSS effort and ability to implement logic that involves patient-specific data from multiple data source

ii. Data-drive mechanism. A data-drive mechanism enables a flag or trigger to be set so that a program can be activated when a particular type of data or data item (e.g., clinical laboratory results or a chest radiograph report) is stored in the database. These triggered events allow for the system to be automatic, real time, and asynchronous. Such systems are real time in that they run as soon as the data is stored, instead of at a specified time of day

iii. Knowledge engineer. An informatics expert who is responsible for extracting and translating the clinical knowledge into machine executable logic

iv. Time-drive mechanism. This allows for programs to be executed automatically at a specific time in the future (e.g., 2 a.m.) or after a specific time interval has passed (24 hours after transfer). Logic can be used to remind clinicians to perform specific activities or to check that the appropriate action has been performed

   - **v.** Long-term clinical data repository. A long-term clinical data repository contains the patient-specific data from a variety of clinical sources collected over a period of several years. It allows for the development of reliable statistical predictors of specific events. For example, one could develop a logistic regression equation that identifies the pathogen most likely to be found in a particular specimen and recommends the least expensive antibiotic. The database could also be used to identify potential problem areas, such as the percentage of patients with diabetes who have not had an HBA1C test performed within the last six months

- **c.** The functions of clinical decision support systems include alerting, reminding, critiquing, interpreting, predicting, diagnosing, interpreting, image recognition, assisting, and suggesting
  - **(1)** One of the benefits of clinical decision support systems is the evidence can be driven into practice in a timely manner
  - **(2)** Garg et al. reported that 76% of reviewed studies indicated that clinician performance was improved through the use of reminders
  - **(3)** Diagnostic aiding systems were found to be beneficial in 40%
  - **(4)** Automatic prompts to the end user were more effective than the end user needing to activate a system with changes in physician performance 73% with auto prompts, and 47% when required to activate the system
  - **(5)** The highest success function identified was the use of reminders and alerts
- **d.** DSS are passive or active
  - **(1)** A passive system would notify an individual of an event, such as an abnormal finding where an active system will offer suggestions or take actions such as place a specific order when specific criteria are met
  - **(2)** DSS always allow for the provider to have the option to ignore the alert, override the alert, or inactivate the alert after their synthesis of the information and suggested actions
  - **(3)** It must always be remembered the clinician is the final decision maker
- **e.** Clinical decision support systems allow for optimization of both the efficiency and effectiveness with which clinical decisions are made and care is delivered
  - **(1)** The costs of clinical decision support systems can be high, however, the savings occur in the improved decision making at the bedside, improved quality and outcomes, and reduction of errors
  - **(2)** Mullett, Evans, Christenson, and Dean concluded at InterMountain Healthcare Primary Children's Medical Center in Utah the use of a pediatric anti-infective decision support tool in the Pediatric Intensive Care Unit (PICU) was beneficial to the patient and reduced the rates of erroneous drug orders, improved therapeutic dosage targets, and decreased anti-infective costs per patient
- **f.** Disparities have been documented by Medicare and other agencies in the treatment of diseases such as heart disease and congestive heart failure
  - **(1)** This was one of the incentives behind the CORE measures to reduce variation in practices when evidence has proven the impact of procedures and medications
  - **(2)** The goal is to reduce variations, cost and improve quality and this is being expanded in 2014 to include CORE measures and quality measures
  - **(3)** CORE measures can be found on the CMS Web site at www.cms.gov/EHR Incentive program

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

What can Outside Reference Sources (Vendors) Bring to the Table?

1. Overview

- **a.** The tools for EBP have evolved from paper and pencil to EBP embedded in the CIS via links and DSS at the point-of-care
  - **(1)** The utilization of technology has also moved the amount of evidence available at the point-of-care from low to high
- **b.** Not only have the methods for using evidence changed, but also the producers or originators of EBP have changed in the past 20 years
  - **(1)** In the 1980s Clinical Practice Guidelines were developed by individual hospitals and the responsibility was on the hospitals
  - **(2)** That trend changed in the 2000s to eliminate healthcare delivery organizations from building their own to their use of commercial vendors for information and incorporation into practice
  - **(3)** Healthcare organizations are no longer building their own evidence-based packages, but instead partnering with governmental agencies (Medicare), professional societies, and companies such as Zynx, Wolters-Kluwer, Thomson, Clineguide, and Micromedex who are in the business of providing evidence-based packages
  - **(4)** The vendors provide the evidence, however, they do not decide what evidence is chosen to incorporate into practice
  - **(5)** With vendors maintaining the responsibility for reviewing the research and presenting the best practices to the facilities the information can be incorporated into the bedside care in a more expeditious manner

- **c.** Electronic health record (EHR) system vendors also provide various services
    - **(1)** Their services can be categorized into three areas
        - **i.** In-house CDS content. Vendors provide a variety of in-house CDS content such as alerts and reminders, order sets, documentation templates, drug–drug and allergy checking and flow sheets. This requires regular updates and client maintenance
        - **ii.** Third-party CDS content. Vendors use third-party CDS content
        - **iii.** Content knowledge sharing. The vendor provides a knowledge sharing environment Options may include a vendor hosted portal where clients can access information provided by the vendor or by its clients on how to implement a specific CDS capability, or a vendor hosted environment where clients share resources such as rules and workflows, and shared benchmarking database with associated analytics

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Integration of EBP Technology in the Clinical Areas

1. Overview
    - **a.** Barriers to research implementation were identified three decades ago
        - **(1)** Melnyk states "although progress has been made over the years, the same barriers to EBP identified decades ago (e.g., time, lack of knowledge and skills, peer resistance, lack of access to resources, and EBP mentors) continue to exist in healthcare systems
        - **(2)** Most recently…new findings indicate that resistance from leaders and managers along with environments steeped in tradition were top barriers to provision of evidence based care"
2. Information access
    - **a.** There are over 150,000 medical articles published each month

Teaching Tip

See Table 40.5 which provides several examples, along with their Web addresses, of sources for EBP available today. Most are free, however, some sites do have a subscription fee.

3. Data, information, knowledge, wisdom, healthcare business intelligence
    - **a.** Worthley defines data as the raw materials from which information is generated and information is the relevant, usable commodity needed by the end user
        - **(1)** "Information is born when data are interpreted"
        - **(2)** In order for information to be useful it needs to be accurate, timely, complete, concise, and relevant
    - **b.** Englebardt and Nelson explain the Nelson Data to Wisdom Continuum:
        - **(1)** Data is provided; data generates information; information generates knowledge and the interpretation, integration, and understanding of knowledge leads to wisdom
        - **(2)** Healthcare business intelligence requires a foundation that encompasses comprehensive data management of reporting, analytics, data warehousing, and dashboards
        - **(3)** Successful business intelligence provides information knowledge at the clinician's fingertips
    - **c.** Five tenets of successful healthcare business intelligence are
        - **(1)** Data quality
        - **(2)** Sponsorship and leadership
        - **(3)** Technology and architecture
        - **(4)** Value
        - **(5)** Culture change
    - **d.** Weiskopf and Weng found there is little consistency in the methods used to assess EHR quality data
        - **(1)** Overhage, Ryan, Reich, Hartzema and Stang, and Weiskoph and Weng believe if the reuse of EHR data for clinical research is to become accepted, researchers and clinicians should adopt validated, systemic methods of EHR data quality assessment
        - **(2)** They empirically derived five dimensions of data:
            - **i.** Completeness: accessibility, accuracy, availability, omission, presence, quality, validity, rate of recording
            - **ii.** Correctness: Is an element present in the EHR true? This dimension includes accuracy, corrections made, errors reported, validity tested
            - **iii.** Concordance: Is there agreement between the elements in the EHR, or between the EHR and other data sources? Other considerations are agreement, consistency, reliability, variation
            - **iv.** Plausibility: Does an element in the EHR make sense in light of other knowledge about what that element is measuring? Are the data accurate, believable, trustworthy, and valid
            - **v.** Currency: Is an element in the EHR a relevant representation of the patient state at a given point in time? This is a dimension of timeliness
        - **(3)** "Although the five dimensions of data quality derived during our review were treated as mutually exclusive within the literature, we feel that only three can be considered fundamental
            - **i.** Correctness
            - **ii.** Completeness
            - **iii.** Currency
        - **(4)** By this we mean that these dimensions are nonreducible and describe the core concepts of data quality as it relates to EHR data reuse"
    - **e.** Bowles et al. found doing research across multiple institutions using the EHR, they present multiple issues, even when working with sites with the same vendor

    - **(1)** Contributing factors identified included differing versions of the EHR, customizations, variations in documentation policies and procedures and quality, and user interfaces

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Technology is Only a Tool for EBP

1. Integration of evidence into healthcare decisions

- **a.** The transition to EBP is a cultural change process
    - **(1)** In 2008, Anderson and Wilson completed a study on the use of CDSS in nursing
    - **(2)** They found only six studies that involved CDSS to promote EBP in nursing
    - **(3)** They concluded that nursing is lagging behind the progress made in other disciplines, however, given the mandate for CDSS to qualify for federal incentives they propose an increase in CDSS use within nursing will occur
- **b.** Castillo and Kelemen identified 12 characteristics of successful clinical decision support systems
    - **(1)** They are
        - **i.** Incorporate into existing systems
        - **ii.** Integrate into the current workflow
        - **iii.** Provide specificity
        - **iv.** Incorporate user involvement
        - **v.** Provide education and training
        - **vi.** Provide sufficient system support
        - **vii.** Provide automated system prompts
        - **viii.** Provide straightforward alerts
        - **ix.** Have simple clinical decision support system displays
        - **x.** Prompt acknowledgment
        - **xi.** Require minimal clinical decision support system data entry
        - **xii.** Have continuous clinical decision support system evaluation and monitoring
- **c.** Brokel, Shaw, and Nicholson found in implementing clinical rules to automate steps in delivering evidence-based care that to be successful there must be
    - **(1)** The use of uniform coded terminologies
    - **(2)** A culture to transform care with the use of evidence-based practices
    - **(3)** Processes in place to guide the organization and staff
    - **(4)** Interdisciplinary involvement which is required to be successful
    - **(5)** The transformation from paper checklist, requires an organizational culture to redesign workflow processes to improve the use of EBP guidelines rules in an EHR
    - **(6)** The health system required an organizational culture to redesign workflow processes to improve the use of evidence-based guidelines
- **d.** Dougherty, Harrison, Graham, Vandyk, and Keeping-Burke identified factors associated with the success and failure of participants' efforts to facilitate EBP
    - **(1)** Note their factors were not technology issues but process and culture, such as engagement, resource deficits, lack of focus on an issue, development of strategic partnerships

Teaching Tip

See Table 40.6 which identifies the complete list of positive and negative factors.

2. Regulatory and accreditation agency impacts

- **a.** There are concerns that many documentation processes and requirements are heavily focused on payment and regulatory requirements rather than care delivery
    - **(1)** Much of what is currently documented and contained in the health record is in response to medico legal, reimbursement, and accreditation and regulatory requirements
    - **(2)** Data capture is influenced by federal and state regulations
    - **(3)** American Recovery and Reconciliation Act (ARRA) and Centers for Medicare and Medicaid (CMS) meaningful use regulations published July 13, 2010 have significantly altered the applications and functionality emphasized
    - **(4)** These acts and regulations have deadlines and monetary incentives and penalties in place for healthcare providers and institutions
    - **(5)** The CMS established 24 objectives for eligible hospitals seeking incentive benefits
    - **(6)** For Stage 1 hospitals are required to meet 14 core objectives and select an additional 5 from the remaining 9 objectives
    - **(7)** One mandatory objective of Meaningful Use is the meaningful use of DSS
    - **(8)** The CMS objective requires that eligible hospitals identify a high-priority condition and then implement one clinical decision support rule related to that condition, along with a way to track compliance
    - **(9)** The Health Information Technology for Economic and Clinical Health (HITECH) Act was enacted in 2009 and seeks to improve patient care outcomes and healthcare delivery through major investments in health IT
    - **(10)** The goals are to improve quality, safety, and efficiency of patient care; engage patients and families, improve care coordination; and ensure adequate privacy and security for personal health information
    - **(11)** Meaningful Use (MU) establishes a set of standards which govern the use of EHRs
    - **(12)** MU stage 1 criteria focused on: electronically capturing health information in a standard format and initiating the reporting of clinical quality measures and provider health information
    - **(13)** Stage 2 criteria focused on health information exchanges, data interoperability, and electronic

transmission of patient care summaries across multiple settings

(14) Stage 3 to be launched in 2016 focus on decision support for national high-priority conditions, improving quality, safety and efficiency, leading to improved health outcomes and access to comprehensive patient data through patient-centered health information exchanges

(15) An additional documentation and data burden is the requirements engendered by CMS, incentive payments for meaningful use such as EHRs ability to report specific data elements, ability to report on certain quality measures, and data exchange between providers and systems for meaningful use objectives and clinical quality measures

b. Opportunities are present to empower nurses with IT tools to leverage the vast clinical knowledge base to improve care, increase patient safety, and meet regulatory requirements

3. Optimizing existing systems and applications

a. The success of a CDS depends on many factors, one of which is end-user satisfaction

(1) A system for which the end user builds workarounds does not provide any benefit

(2) Three barriers have been identified

(3) They are

i. Excessive use of alerts and reminders

ii. Outdated or inaccurate information in the system

iii. Inappropriate levels of the alerts

b. Lyerla explains "a reminder or alert that is too general may produce too many messages and result in clinician frustration, causing the reminder to be ignored, whereas a system that is too specific may not produce enough messages resulting in missed appropriate messages"

(1) The development of intelligent systems will depend on high-quality data derived from patient and clinical sources

(2) The EHR will continue to be a major source of information along with data for a clinical data warehouse

(3) One important challenge which remains is the high prevalence of narrative text in the electronic record

(4) Currently there is work on natural language processing and information retrieval, however, it has not been perfected to meet the criteria for standardized language

c. It is imperative that technology assists in getting evidence to nurses at the point-of-care

(1) Again, this can be accomplished via various methods such as embedded hyperlinks, text messages, and icons

(2) Nurses need access to the information during their care provision, not 3 hours later

(3) The integration of the evidence into daily workflows is essential so clinicians can move readily from task-based care to managing care and knowledge-based decisions

(4) When this is achieved Matter explains the clinicians will be functioning at an elevated level of critical thinking and incorporate EBP into their daily work to improve efficiency, effectiveness, and patient outcomes

d. The AMIA 2011 policy meeting stated "The consensus of the meeting was that, in the move to technology-enabled healthcare environment, the main purpose of documentation should be to support patient care and improved outcomes for individuals and populations and that documentation for other purposes should be generated as a byproduct of care delivery"

SUMMARY

- Karlene Kerfoot (2009) states "Nurses are either professional owners of their practice or merely renters"
- Nurses who own their practice are personally involved and care about their outcomes
- They feel accountable for their practice and treat it like an owner would
- It is necessary to create transparency
- Nurses who own their practice need information to take the appropriate actions and make the correct decisions
- To support this model, nurses need access to real-time information they can use to intervene and analyze care
- This includes information from both internal and external sources
- They need to be able to use the power of information effectively with the help of information technology, decision support systems, and evidence-based practice to change their practice and be responsible for their outcomes
- Evidence-based practice is not just about connecting nurses with the evidence, it is also about transforming the structures and culture of healthcare organizations to enable staff nurses to use research evidence to make more effective decisions
- The evidence does not make the decisions, people do and people work in environments which can encourage or discourage evidence-based practice approaches
- Technology can readily support evidence-based practice, however, it is only a tool
- Florence Nightingale wrote "Let whoever is in charge keep this simple question in her head. Not how can I always do the right thing myself, but how can I provide for this right thing to always be done?"
- The electronic health record and evidence-based practice have made great strides in the past 20 years
- We are moving forward with providing evidence-based usable information at the point-of-care in a transparent format to not only meet regulatory, reimbursement, and government requirements, but also improve quality and outcomes and reduce costs and variations in care
- The end result is to produce a more enhanced, transparent, and comprehensive system for individualized use by both patients and care providers

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Define evidence-based practice
- Discuss how evidence-based practice impacts healthcare quality, safety, and cost reduction
- Discuss barriers and facilitators for successful implementation of evidence-based practice in the clinical setting
- Discuss the evidence-based practice paradigm and process
- Identify technology tools in clinical practice which support evidence-based practice
- Discuss the role of clinical decision support systems in evidence-based practice
- Identify considerations for a successful clinical decision support system
- Discuss the integration of evidence-based practice in clinical areas
- Discuss a professional practice model which supports evidence-based practice
- Identify data types of standardized terminology
- Explain the differences between data, information, knowledge, and wisdom
- Discuss options available with vendors in support of evidence-based practice
- Identify regulatory and agency impacts on decision support

Teaching Tip

Ask the students to define the keywords

- Evidence-based practice
- Decision support
- Clinical decision support
- Evidence-based adaptive clinical decision support
- PICOT
- Data
- Nursing informatics
- Clinical terminology
- Technology tools
- Professional practice model
- Quality measures

CHAPTER REVIEW QUESTIONS

Question 40.1: Evidence-based practice is defined as:

a. A problem-solving approach to the delivery of care that integrates the best evidence from well-designed studies with a clinician's expertise and patient preferences and values in making clinical decisions

b. A decision support tool based upon policies for improving quality in an institution

c. A problem-solving approach that must be mapped to the institution's strategic plan

d. A cookbook for principles to follow when using devices in any community of practice

Question 40.2: What is one way that evidence-based practice impacts healthcare quality, safety, and cost reduction?

a. Evidence-based practice impacts quality and safety and costs by being compliant with the Joint Commission requirements only

b. Evidence-based practice imbeds guidelines for targeted area where quality is already high

c. Evidence-based usable information at the point-of-care in a transparent format to not only meet regulatory, reimbursement, and government requirements, but also improve quality and outcomes and reduce costs and variations in care

d. Evidence-based usable information in an EHR and decision support tools are automate ways of assuring quality at reduced costs

Question 40.3: Seven steps in the process of evidence-based practice include ________?

a. Conduct a needs assessment of the data needed, conduct a requirements analysis of technical needs, conduct a requirements analysis of functional needs, establish a committee for governance, establish a committee for education, set up a social media network to clinicians, and establish a patient portal

b. Cultivate a spirit of inquiry, ask the burning clinical questions in a PICOT format, search for and collect the most relevant best evidence, critically appraise the evidence, integrate the best evidence with one's clinical expertise and patients preferences and values in making a practice decision or change, evaluate outcomes of the practice decision or change based on evidence, disseminate the outcomes of the evidence-based practice decision or change

c. Survey the nurses of the needs, survey the patients of the needs, survey the doctors of the needs, survey the pharmacy department of the needs, do a business process analysis of the hospital, do a complex system analysis of the strategic goals of the hospital

d. None of the above

Question 40.4: PICOT includes what elements in the assessment of evidence?

a. Patient, input, computer, output, technology

b. Patient population, intervention or interest area, comparison interventions or group, outcomes, and time

c. Planning process, interventions, classifications, outcomes, and time

d. Patient care plans, implementation strategies, classifications of data, outcomes, and technology

Question 40.5: Examples of resources that support evidence-based practice include:

a. Money, policies, and personnel only

b. Information technology is the only support needed for evidence-based practice

c. Evidence-based practice designated computers, clinical decision support tools, evidence-based policies and procedures, advances nurse practitioner with knowledge, clinicians with excellent evidence-based practice skills, clinicians with knowledge in individual and organizational change strategies, and annual evidence-based practice poster and/or conference events

d. a and b only

Question 40.6: What culture and process factors facilitate evidence-based practice?

a. A focus on a priority issue, relevant evidence, development of strategic partnerships, use of multiple strategies to effect change, facilitator characteristics and approach

b. Poor engagement or ownership, resource deficits, contextual issues, and lack of evaluation or sustainability facilitate evidence-based practice

c. Lack of evidence, a good electronic health record, a strong quality assurance department, the use of IT technology supports such as access to literature sources

d. Open access to literature and evidence-based guidelines

Question 40.7: What are the barriers to implementing evidence-based practice?

a. Misperceptions by clinicians that it takes too much time, and lack of EBP knowledge and skill

b. Organizational cultures that do not support EBP, and lack of resources, including clinical decision support tools

c. Executive leaders and managers who do not model and/or support EBP, and lack of EBP mentors to work with point-of-care staff on implementing evidence-based care, inadequate access to databases by clinicians in order to track patient and system outcomes, and negative attitudes toward research

d. All of the above

Question 40.8: Name two technologies that support evidence-based practice?

a. EHRs and decision support tools

b. Decision support tools and computerized decision support tools only

c. EHRs from the hospital and the personal health record alone

d. b and c

Question 40.9: The data to wisdom continuum is defined as ________________?

a. Data automatically becomes wisdom when it is embedded into the EHR

b. Data is provided; data generates information; information generates knowledge and the interpretation, integration, and understanding of knowledge leads to wisdom

c. Data is converted to information in an information system and can automatically become wisdom when used

d. Data is provided and generates information which when used in decision making becomes wisdom

Question 40.10: True or False? Standardized clinical terminology is necessary for evidence to be both computable and interoperable with multiple systems.

ANSWERS AND EXPLANATIONS

Question 40.1: (a) According to Melnyk and Fineout-Overholt in 2011, evidence-based practice is a problem-solving approach to the delivery of care that integrates the best evidence from well-designed studies with a clinician's expertise and patient preferences and values in making clinical decisions.

Question 40.2: (c) Evidence-based usable information at the point-of-care in a transparent format not only meets regulatory, reimbursement, and government requirements, but also improves quality and outcomes and reduce costs and variations in care.

Question 40.3: (b) The seven-step process includes: cultivate a spirit of inquiry, ask the burning clinical questions in a PICOT format, search for and collect the most relevant best evidence, critically appraise the evidence, integrate the best evidence with one's clinical expertise and patients preferences and values in making a practice decision or change, evaluate outcomes of the practice decision or change based on evidence, disseminate the outcomes of the evidence-based practice decision or change.

Question 40.4: (b) P = patient population, I = intervention or interest area, C = comparison intervention or group, O = outcome, and T = time.

Question 40.5: (c) Resources that support evidence-based practice include: evidence-based practice designated computers, clinical decision support tools, evidence-based policies and procedures, advances nurse practitioner with knowledge, clinicians with excellent evidence-based practice skills, clinicians with knowledge in individual and organizational change strategies, and annual evidence-based practice poster and/or conference events.

Question 40.6: (a) A focus on a priority issue, relevant evidence, development of strategic partnerships, use of multiple strategies to effect change, facilitator characteristics and approach.

Question 40.7: (d) All of the above. The barriers to evidence-based practice include: misperceptions by clinicians that it takes too much time, and lack of EBP knowledge and skill, organizational cultures that do not support EBP, and lack of resources, including clinical decision support tools, executive leaders and managers who do not model and/or support EBP, and lack of EBP mentors to work with point-of-care staff on implementing evidence-based care, inadequate access to databases by clinicians in order to track patient and system outcomes, and negative attitudes toward research.

Question 40.8: (a) EHRs and decision support tools.

Question 40.9: (b) Data is provided; data generates information; information generates knowledge and the interpretation, integration, and understanding of knowledge leads to wisdom.

Question 40.10: True. Standardized clinical terminology is necessary for evidence to be both computable and interoperable with multiple systems. To be efficient, the evidence for EBP must be incorporated into the everyday workflows and care processes used by nurses and other healthcare providers. The data must be integrated with the clinical systems used by the providers and provide readily accessible evidence-based knowledge for the end user at the point-of-care when needed.

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Incorporating Evidence: Use of Computer-Based Clinical Decision Support Systems for Health Professionals

• OBJECTIVES

1. Describe computerized clinical decision support systems (CDSS), including types, characteristics, and the levels of responsibility implicit in the use of each type.
2. Describe the effects of CDSS on clinician performance and patient outcomes in healthcare.
3. Understand the features, benefits, and limits of CDSS.
4. Discuss the relationship of DSS to electronic health records and meaningful use.
5. Develop a future vision for CDSS within nursing.

• KEY WORDS

Clinical decision support
Decision support systems
Information systems
Knowledge and cognition
Meaningful use

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Have you used decision support? Can you give an example of decision support? Was it helpful? Did it help you make a better decision? Can you define clinical decision support? Can you give examples of clinical decision support?

For a WIIFM statement, say to the class, "This chapter focuses on the translation of evidence into practice and how translation intersects with technology." As a nurse, it is important to understand the evidenced-based practice and the intersection with technology.

Class Preparation

1. Review the references and Web sites listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
   a. Decision support systems (DSS) are automated tools designed to support decision-making activities and improve the decision-making process and decision outcomes
      (1) Such systems are intended to use the enormous amounts of data that exist in information systems to facilitate decision processes
      (2) A clinical decision support system (CDSS), designed to support healthcare providers in making decisions about the delivery and management of patient care, has

the potential to improve patient safety and outcomes for specific patient populations, as well as compliance with clinical guidelines and standards of practice and regulatory requirements

    (3) Within the complexity of today's healthcare environment, there is an increasing need for accessible information that supports and improves the effectiveness of decision making and promotes clinical accountability and the use of best practices
    (4) Clinical tasks to which CDSS may be applied include alerts and reminders, diagnostic assistance, therapy critiques and plans, medication orders, image recognition and interpretation, trend analysis, and information retrieval
    (5) The primary goal of CDSS is to optimize the efficiency and effectiveness with which clinical decisions are made in order to improve the manner in which care is delivered
    (6) Without the ability to recall and process all available complex information, decisions in healthcare often cannot be justified on the basis of available knowledge, costs, benefits, possible risks, and patient preferences

b. Clinicians depend on timely, reliable, and accurate information to make clinical decisions

    (1) Availability of such information depends on how data are collected, stored, retrieved, and transformed into meaningful information
    (2) Computers have virtually unlimited capacity for processing and storage of data
    (3) Humans, on the other hand, have limited storage (memory) and processing power, but do have judgment, experience, and intuition
    (4) DSS integrate and capitalize on the strengths of both
    (5) Improving the efficiency and effectiveness of nursing practice supports the demand for more and more professional accountability for practice
    (6) Consequently, CDSSs tools that aid nurses in improving their effectiveness in care delivery, identifying appropriate interventions, determining areas in need of policy or protocol development, and supporting patient safety initiatives and quality improvement activities are increasingly needed
    (7) Accuracy, timeliness, availability, and reliability of information are just as important to nursing as they are to other healthcare providers
    (8) Nurses as knowledge workers need access to current knowledge where it is useful: in clinics, at the bedside, in homes, offices, and in research that makes contributions to evidence-based nursing practice
    (9) Nursing, as a learning discipline, requires current practice information to inform future care

c. A CDSS includes a set of knowledge-based tools that can be fully integrated with the clinical data embedded in the electronic health record (EHR) to assist providers by presenting information relevant to the healthcare problem(s) being faced

    (1) The ideal CDSS is available at the point-of-care with quick (real time) responses, requires minimal training, is easily integrated into the practice workflow, and is user friendly
    (2) It should have a powerful search function that can access useful and reliable information from existing knowledge sources
    (3) These may include electronic libraries, medical dictionaries, drug formularies, other databases, and expert opinion
    (4) A CDSS is only as effective and accurate as its underlying knowledge base
    (5) Knowledge sources can provide simple facts, relationships, evidence-based best practices, and the latest in clinical research
    (6) CDSS may focus on treatment, diagnosis, population health management, or specific patient information
    (7) Systems may be passive, requiring the clinician to access (pull) the advice or with a higher level of information processing, systems may be active, giving unsolicited advice (push)

d. The availability of reliable clinical information and the propagation and management of clinical knowledge within CDSS has the potential to transform healthcare delivery

    (1) However, it is important to remember that the clinical user's experience, knowledge base, and understanding of the current context of care are not replaced by, but, rather, supported in the decision-making process
    (2) In no way does a CDSS usurp the clinician's decision-making role
    (3) Final decisions should always be made by clinicians who can accept or reject the CDSS information within the context of the existing healthcare situation
    (4) Implementation of CDSS requires the development of a strategy built on an understanding of available CDSS tools, clinician readiness to adopt and use CDSS, and areas within the organization that carry significant risks to patient safety
    (5) CDSS is a "tool" system, not a "rule" system
    (6) As decision making is optimized, compliance with current, evidenced-based guidelines increases
    (7) Choices for diagnostics or treatment are increasingly supported by evidence
    (8) Consequently, chronic condition management and patient workups will be more focused in the future

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CDSS Definitions and Concepts

1. Overview

a. "Clinical Decision Support is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery

    (1) Information recipients can include patients, clinicians and others involved in patient care delivery; information delivered can include general clinical knowledge and guidance, intelligently processed patient data, or a mixture of both; and information delivery formats can be drawn from a rich palette of options that includes data and order entry facilitators, filtered data displays, reference information, alerts and others"

(2) According to Health Information Management Systems Society (HIMSS), "**clinical decision support** is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery"

(3) "Clinical decision support (CDS) provides clinicians, staff, patients or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and healthcare

(4) CDS encompasses a variety of tools to enhance decision-making in the clinical workflow

(5) These tools include computerized alerts and reminders to care providers and patients; clinical guidelines; condition-specific order sets; focused patient data reports and summaries; documentation templates; diagnostic support, and contextually relevant reference information, among other tools"

b. In 2007, the American Medical Informatics Association (AMIA) developed a roadmap for action on CDS

(1) Osheroff et al. identified a framework of three pillars supporting the full benefits of CDS

(2) These pillars were

i. Best knowledge available when needed

ii. High adoption and effective use

iii. Continuous improvement of knowledge and CDS methods

(3) The AMIA roadmap identified the tasks that would lead to widespread successful use of CDS

(4) At that time, it was recognized that no public or private entity existed that could be responsible for a work plan

(5) A relatively new initiative to promote action on the use of CDS is the CDS/PI Collaborative, a multistakeholder collaborative launched by TMIT Consulting, a firm founded by Dr. Jerome Osheroff in 2011

(6) The CDS/PI Collaborative goal is "better use of clinical decision support to address healthcare imperatives for improvement in quality, patient safety, patient satisfaction and cost control"

(7) Products of this collaborative effort include the development of a CDS configuration template, a set of resources designed to improve care with CDS, identification of benefits of the use of CDS for providers, stakeholders, vendors, and the identification and explanation of the "five rights" of CDS

c. Nurses are familiar with the "five rights" related to medication administration and recently the concept has been applied to CDS as the "right information to the right people in the right intervention formats through the right channels at the right point in workflow"

(1) The expectation of the application of the five rights of CDS is that healthcare-related decisions and patients outcomes will be improved

d. CDSS software has a knowledge base designed for the clinician to aid in clinical decision making related to patient care

(1) The computer has virtually unlimited capacity for processing and storage of data

(2) The human, on the other hand, has limited storage (memory) and processing power, but does have judgment, experience, and intuition

(3) DSS integrate and capitalize the strengths of both

(4) The three key purposes of a DSS are to assist in problem solving with semi-structured problems, support but not replace, the judgment of a manager or clinician, and improve the effectiveness of the decision-making process

(5) Highly structured or deterministic problems, which can be solved with existing facts, and completely unstructured problems, which are highly dependent on values and beliefs, are generally not well suited for decision support

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CDSS Impact on Clinicians

1. Overview

a. There is growing pressure for clinicians including nurses to use knowledge at the point-of-care that is based on researched evidence

(1) The use of CDSS to find and prevent errors related to gaps between optimal and actual practice can result in improved quality of care

(2) Applications of CDSS suggest the ability to lessen the incidence of adverse drug events, nosocomial infections, and the inappropriate use of antibiotics

(3) Successful use of a CDSS requires integration with the user's normal workflow

(4) Of significance to clinicians is the integration of CDSS within clinical workflow

(5) If the use of a CDSS does not fit into the normal sequence of care delivery it will not be adopted for use

(6) This means that user requirements must be translated into a system that supports workflow while incorporating evidence to improve practice

(7) CDSS must be designed to support clinician requirements rather than dictate clinician workflow practices

(8) The involvement of healthcare professionals in CDSS selection is essential to system acceptance

(9) It is important to consider how a CDSS will affect organizational culture, practice, and personnel attitudes

b. Nurses have begun development of CDSS specific for their practice as well as using existing CDSS

Teaching Tip

For instance, nurses may use MEWS (Modified Early Warning System), a bedside tool that uses vital signs to identify patients likely to deteriorate. At least one hospital has moved this tool to an electronic format providing for more speed in the decision process with a 50% reduction in code blue events. Bowles and colleagues implemented and tested an interdisciplinary DSS tool to standardize and improve the discharge planning process. Skiba, Cleveland, Gilbert, and Dandreau have addressed the effectiveness of CDSS on the implementation of obesity prevention guidelines.

- **c.** The move to the EHR has led to an understanding of the dual nature of information needs for decision support
    - **(1)** First, evidenced-based information (content) needs to be available at the point-of-care to inform the **present** patient encounter
    - **(2)** Second, key data entered in the process of documentation needs to be entered in a manner that it can be able to be aggregated to inform **future** patient encounters
    - **(3)** New knowledge becomes a transparent by-product of care and move from ***"TRIP"—translating research into practice to "TPIR"—translating practice into research***
    - **(4)** The lag of practice behind knowledge could be shortened if not eliminated by the availability of current knowledge to support the decision-making process

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Classic CDSS Content

1. Overview

- **a.** Included in the field of healthcare decision support are systems that support organizational, executive/managerial, financial, and clinical decisions
    - **(1)** Administrative systems, including those designed for finance or quality, generally support the business decision-making process
    - **(2)** These systems encompass decision processes for other than direct patient care delivery, and even if clinical in nature, such as quality improvement systems, are mainly used for strategic planning, budgeting, financial analysis, quality management, continuous process improvement, and clinical benchmarking
    - **(3)** In these systems, decisions occur at the strategic, tactical, population, or aggregate and operational levels, not at the individual level
    - **(4)** The CDSS focus on real-time decision support, goal orientation, and intelligence gathering, and are designed to be used at the point-of-care by clinicians
    - **(5)** Recently, healthcare agencies have begun to understand that combination systems offer optimal value to the organization
    - **(6)** Such systems are able to support outcomes performance management by integrating operational data (the business side)—budgeting, executive decision making, financial analysis, quality management, and strategic planning data—with clinical data (the clinical side)—clinical event tracking, results reporting, pharmaceutical ordering and dispensation, differential diagnoses, real-time clinical pathways, literature research, and clinical alerts
    - **(7)** The goals of a CDSS implementation are variable but address the use of best clinical practices, patient safety, and patient empowerment as well as the financial well-being of the institution
- **b.** DSSs could be divided into data based (population based), model based (case based), knowledge based (rule based), and graphics based
    - **(1)** In this view, a *data-based* system provides decision support with a population perspective and uses routinely collected, longitudinal, cohort, and cross-sectional databases
    - **(2)** Population-based information is used to enhance clinical decision making, and enhance medical practice
    - **(3)** A *model-based* DSS is driven by access to and manipulation of a statistical, financial, optimization, and/or simulation
    - **(4)** The data in this instance is compared to various decision-making and analytic models
    - **(5)** A model is a generalization that can be used to describe the relationships among a number of observations to represent a perception of how things fit together
    - **(6)** The models may be pathophysiologic, statistical, or analytic. Some model-based examples are lineal programming, such as scheduling nurses or physicians or resource allocation, simulation, such as emergency department or operating room scheduling or provider profiling
- **c.** A *knowledge-based* system relies on expert knowledge that is either embedded in the system or accessible from another source and uses some type of knowledge acquisition process to understand and capture the cognitive processes of healthcare providers
    - **(1)** Much of what is considered evidence-based practice refers to knowledge-based decision support
    - **(2)** Yet there are many issues with maintaining current evidence in DSS
    - **(3)** Such issues include identifying the policy and research challenges in developing and maintaining practice evidence in machine readable repositories
    - **(4)** The DSS experts have coined a term "evidence-adaptable CDSSs" to describe a new type of CDSS that has a knowledge base that is constantly updated with the most current evidence available and is viewed as both a goal and necessity
- **d.** The construction and upkeep of clinical protocols or guidelines is not easy
    - **(1)** Often there are multiple authors, protocol selection is not always straightforward, multiple protocols may be available, or there is a situation that demands a departure from protocols assumptions

(2) Some early expert systems were referred to as using the "Greek Oracle" approach, where the DSS provided a solution from "on high," but others have called for a "catalyst" approach, whereby the DSS serves as a catalyst and provides guidance, but the user remains in control

e. In many ways, CDSS distinctions are somewhat artificial and are increasingly blurred

(1) A very simplistic, broad view of DSS is a "push–pull" distinction mentioned earlier

(2) In a "pull" system, the provider needs to take some action independent of the usual workflow to initiate a request for support or to query the system for additional information; whereas in a "push" system the system automatically generates the alert in response to a clinician action such as a medication order for which the patient has reported an allergy

f. CDSS development

(1) CDSS development requires a team approach

(2) The first step in the development process is identification of the information needs that leads to the question of whether a CDSS would be helpful

(3) Next is the need to identify the stakeholders with interest in the topic

(4) Stakeholders can include physicians, nurses, administrative staff, Quality and Safety Education in Nursing (QSEN) staff, and even patients

(5) As a group, the stakeholders must address CDSS goals

(6) It is important to synthesize and validate a unified working list of goals and objectives

(7) As the specific clinical issue is addressed, determination of potential frequency of use is necessary to determine whether assignment of resources to a development project is justified

i. Is this a frequently encountered unstructured or semi-structured problem?

ii. Is there sufficient evidence that justifies the assignment of necessary resources for development?

iii. Is the proposed CDSS to be built to address process and outcome data, departmental needs, the needs within the community of service, or a result of reporting and accreditation issues?

iv. Will the proposed system address a strategic target such as medication safety?

(8) If the decision is to move forward, an inventory of all available information systems such as laboratory, radiology, and pharmacy systems as well as the clinical record system, order systems, and administrative systems may be data and information sources

(9) CDSS capabilities depend on availability of coded data, use of standard vocabularies, and the ability to aggregate data from multiple sources

g. The knowledge base of the CDSS must be clearly defined and a system for knowledge update must be in place

(1) After the system inventory, it is necessary to select CDSS interventions as part of the process of developing specifications for the system build

(2) Building the CDSS requires an identification of when and how interventions are triggered, the data source and content of the intervention, how the information is delivered to the recipient, and also needs a feedback mechanism

(3) After a CDSS is built, it must be tested and only then should it "go live"

(4) The system launch requires planning that addresses not just a date but all the necessary educational preparation of the end users

(5) The final step of CDSS development is evaluation and system enhancement as needed

(6) Ongoing assessment of intervention use and usability, evaluation of intervention performance against objectives, and continuous enhancement of CDSS provides value to users

h. A successful CDSS emerges from and supports performance improvement initiatives

(1) The choice of a CDSS target may be related to a patient benefit that outweighs any possibility of harm, practices supported by evidence, physician practice patterns, disease management, chronic care management, and national quality measures

(2) Also considered is the gap that exists between what is ideal and what is real

(3) The CDSS development looks at preventing errors, optimizing decision making, and improving the care process

i. CDSS governance involves executive leadership, management oversight, project managers, and the end users

(1) Successful development and implementation depends on strong executive support for clinical quality improvement and belief in information technology (IT) as a tool to achieve desired quality

(2) A history of previously successful IT projects has a positive impact

(3) Communication with the stakeholders must be successful and the key end users must be involved in implementation

j. Osheroff et al. identified a taxonomy of CDS interventions for data entry, data review, and the tasks of assessment and understanding as well as CDS that can be either time or data triggers

Teaching Tip
See Table 41.1.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Knowledge and Cognitive Processes

1. Overview

a. Knowledge engineering is the field concerned with knowledge acquisition (extracting or eliciting knowledge from experts) and the organization and structure of that knowledge within a computer system

(1) Building a knowledge-based or expert system requires an understanding of the cognitive processes of healthcare providers and how they deal with complexity

(2) Most DSS take advantage of the research on human reasoning and decision making

b. How do nurses solve problem

(1) Or even determine that there is a problem

(2) What information-seeking behaviors do nurses use

(3) Is "intuition" really a case of statistical pattern recognition

(4) When an expert nurse claims that the patient "just didn't look right," is it intuition or do years of nursing experience place that patient three standard deviations from the mean of all the patients cared for

(5) Answering these questions requires an understanding of the decision-making process, human diagnostic reasoning, and critical thinking

(6) Nurses recognize various types of knowledge such as declarative knowledge and procedural knowledge

(7) Declarative knowledge can be considered the "know what" or descriptive knowledge, procedural knowledge is the "know how," and the processes of reasoning and inference produce the "know why"

c. A variety of methods have been used to elicit knowledge from expert clinicians

(1) Some knowledge elicitation techniques require clinicians to "think aloud"

(2) The term surveillance is used to describe nurses' cognitive work in identifying and preventing patient complications

(3) Rhudy and Androwich explored surveillance in the context of early recognition of patient complications

(4) Their findings suggest that nurses do use surveillance and cues from change-of-shift handoff information to develop a mental image of the patient, which serves as a baseline for evaluating the patient's current state and making patient care decisions

(5) Interviews with experts have been the most commonly used method of eliciting knowledge

(6) The expert clinician is directly asked in a structured interview to describe a typical case and how aspects of the case influence care decisions

(7) The advantages of this method are ease of use and the ability to draw out important information; however, a potential problem may be that the experts tend to say what they *think* that they do, but may be unaware of what they are actually doing or they may be unable to break down their thought processes into steps

d. Cognitive Task Analysis (CTA) refers to a set of methods that capture the skills, knowledge, and processing ability of experts in dealing with complex tasks

(1) The goal of CTA is to tap into "higher order" cognitive functions. This technique is beneficial in comparing the performance of an expert with the performance of someone less than expert

(2) CTA attempts to identify pitfalls or trouble spots in the reasoning process of the beginner or intermediate level practitioner while comparing the reasoning process with that of the expert

e. Another important aspect of data presentation for ease of understanding and accuracy of decision making is the manner with which the clinician is able to visualize of patient data for decision making

(1) Edward Tufte, in his seminal works on the visual display of data, demonstrated that the manner in which the data is displayed can lead to accurate or inaccurate decisions

(2) He was able to demonstrate that had a "full" data picture been available, the "O ring" failure that led to the tragic crash of the Challenger Missile could have been avoided

(3) Computer-based techniques which use interactive tools are also used to assess decision making

(4) These tools have the advantage of not needing to interact directly with the clinician but also tend to be overly simplistic for complex decision analysis

(5) Rating and sorting methods, borrowed from the social sciences and protocol analysis, are also methods used

(6) Each has advantages and disadvantages

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CDSS and Meaningful Use

1. Overview

a. The Center for Medicare and Medicaid Programs provide financial incentives for the "meaningful use" (MU) of certified EHR technology to improve the quality of patient care and "inform clinical decisions at the point-of-care"

(1) Incentives are based on how providers show that they are "meaningfully using" their EHR data

(2) The CDSS Taskforce of HIMSS worked on developing a link between CDS and specific Meaningful Use (MU)

(3) Implementation of MU in three stages

(4) Stage 1 focuses on the capture and sharing of data; stage 2 focuses on advancing clinical processes; and stage 3 addresses improved outcomes

(5) Stage 1 achievement of meaningful use requires that at least one CDS rule be implemented and monitored for provider compliance

(6) Stage 2 of the Meaningful use requires that CDS be used to improve performance on high-priority health conditions

(7) A CDSS could address the meaningful use objectives of drug, drug–drug, drug–allergy, and drug formulary checks, and support the maintenance of a medication allergy list

    (8) A CDSS deployed effectively can optimize its value in targeted clinical outcome measures and can assist in the management of chronic conditions
    (9) In 2010, Weingarten predicted that CDS would feature prominently in defining meaningful use
    (10) Beginning in 2014, all Medicare-eligible providers must electronically report their Clinical Quality Measures (CQM) data to CMS in order to demonstrate meaningful use
    (11) A CDSS deployed effectively can optimize its value in targeted clinical outcome measures

2. **Patient decision support**
    - **a.** Another important area of decision support is patient decision support (PDS)
        - **(1)** Given the opportunity, patients may become more engaged in self-care when patients as well as clinicians have the information needed to make better decisions
        - **(2)** It can be difficult for patients to speak up during medical visits and they often struggle to communicate their needs and opinions to their providers
        - **(3)** Online tools exist that can help the patient and family identify areas in which they may need help when making healthcare decisions
    - **b.** PDS tools assist patients in communicating with their providers and using medical evidence to make informed choices that are consistent with the patient's values while using evidence about consequences of medical alternatives
        - **(1)** One systematic review of PDS literature has shown that PDS interventions increase patients' knowledge, produce more accurate expectations, and lead to more conservative approaches to treatment that are more congruent with patients' informed preferences
        - **(2)** Innovations in healthcare may be the key to the development of more personalized and effective PDS tools

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Responsibility of User: Ethical and Legal Issues

1. **Overview**
    - **a.** The legal responsibility for treatment and advice given to a patient rests with the clinician regardless of whether a CDSS is used
        - **(1)** Still unknown are the legal ramifications of not following CDSS advice
        - **(2)** One must always consider the potential of adverse consequences but there seems to be no major adverse effect from the use of a CDSS; however, such systems must be developed with high standards of quality
        - **(3)** There must be some way to provide a high degree of assurance that a CDSS has been developed according to quality and safety standards
        - **(4)** CDSS will be expected to comply with a "duty of care" if CDSS is to become safely integrated into routine patient care
        - **(5)** The knowledge base of a CDSS must be as reflective as possible of the current state of professional and scientific opinion and evidence and must draw upon traditional knowledge sources such as journals and textbooks to maintain currency
        - **(6)** CDSS documentation should address the purpose of the system, the population for which the application is intended along with inclusion/exclusion criteria, the context for use, the expected user skill level, evidence source(s), and review and update methods
        - **(7)** Keeping a CDSS current requires a commitment of technical, professional, and organizational dimensions
        - **(8)** Any CDSS will be only as effective as the strength and accuracy of the underlying evidence base
        - **(9)** The knowledge base of a CDSS must be as reflective as possible of the current state of professional and scientific opinion and evidence and must also draw upon traditional knowledge sources to maintain currency
        - **(10)** CDSS documentation should address the purpose of the system, the population for which the application is intended along with inclusion/exclusion criteria, the context for use, the expected user skill level, evidence source(s), and review and update methods

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Future of CDSS

1. **Overview**
    - **a.** Despite the many challenges of developing and implementing CDSS, it is clear that the use of decision support will increase
        - **(1)** Today's healthcare environment is complicated by diverse priorities, providers, and practice modes
        - **(2)** The evidence needed for improved practice is in the patients' records
        - **(3)** CDSS development has been promoted with the increased focus on and expanded implementation of EHRs, an improved understanding of the potential benefits of CDSS, and the incentives for meaningful use
        - **(4)** Vendors are beginning to include CDSS in their products
        - **(5)** Acceptance depends largely on organizational culture, leadership attitudes, and provider involvement

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- The development of CDSS requires a huge financial and intellectual investment, but also represents the potential of reduction in care costs through improvement of the decision process at the point-of-care and a reduction in the possibility of costly errors
- Current evidence indicates that CDSS can improve patient care quality, reduce medication errors, minimize variances in care, improve guideline compliance, and promote cost savings
- Wider implementation of EHRs and the incentives for the use of CDSS are tied to the Meaningful Use initiative of CMS
- Wider adoption of such tools will support clinical care decisions through the provision of additional and current information at the time and place of care delivery while final decision authority will remain with the clinician
- Ease of use within existing workflow practice will determine the success of a CDSS
- Although no one single CDSS is in widespread use, such systems, whether simple or complex, are becoming ubiquitous and research on the use of CDSS is growing

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe computerized clinical decision support systems (CDSS), including types, characteristics, and the levels of responsibility implicit in the use of each type
- Describe the effects of CDSS on clinician performance and patient outcomes in healthcare
- Understand the features, benefits, and limits of CDSS
- Discuss the relationship of DSS to electronic health records and meaningful use
- Develop a future vision for CDSS within nursing

Teaching Tip

Ask the students to define the keywords

- Clinical decision support
- Decision support systems
- Information systems
- Knowledge and cognition
- Meaningful use

CHAPTER REVIEW QUESTIONS

Question 41.1: What are the types of computerized clinical decision support systems?

a. Data entry
b. Data review
c. Assessment and understanding
d. All of the above

Question 41.2: How is clinical decision support defined?

a. Clinical decision support is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery. Information recipients can include patients, clinicians, and others involved in patient care delivery; information delivered can include general clinical knowledge and guidance, intelligently processed patient data, or a mixture of both; and information delivery formats can be drawn from a rich palette of options that includes data and order entry facilitators, filtered data displays, reference information, alerts, and others
b. Clinical decision support is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery
c. a and b
d. None of the above

Question 41.3: How are computerized clinical decision support systems used to improve clinicians performance?

a. There is no relationship between computerized clinical decision support systems and the ability to improve clinician's performance
b. There is no research to support the concept that adoption of computerized clinical decision support systems support clinical care and improve clinician's performance
c. Adoption of computerized clinical decision support systems support clinical care decisions through the provision of additional and current information at the time and place of care delivery while final decision authority will remain with the clinician
d. Adoption of computerized clinical decision support systems only support clinical care decisions by providing financial comparisons of diagnosis and treatment options

Question 41.4: Are computerized clinical decision support systems used to improve patient outcomes in healthcare?

a. Current evidence indicates that CDSS can improve patient care quality, reduce medication errors, minimize variances in care, improve guideline compliance, and promote cost savings
b. It will take considerable more research to demonstrate that CDSS can improve patient outcomes in healthcare
c. There is sufficient evidence at this time to indicate that CDSS cannot improve patient outcomes in healthcare
d. None of the above are correct statements

Question 41.5: What is the single most important characteristics of the CDSS to predict success?

a. Proximity to the nurse's station will determine the success of a CDSS
b. Ease of use within existing workflow practice will determine the success of a CDSS.

c. The volume of data in the CDSS will determine the success of a CDSS

d. The certified content of the data in the CDSS will determine success of the CDSS

Question 41.6: What are three pillars of the computerized clinical decision support system?

a. Best knowledge available when needed, high adoption and effective use, and continuous improvement in knowledge

b. Ability to impact effectiveness, efficiency, and costs of care

c. Best knowledge available, ability to impact efficiency of care, and costs of care

d. Ability to provide continuous improvement in knowledge, best availability of financial data, and best availability of outcomes data

Question 41.7: Why is clinical decision support easily used in computerized systems?

a. Clinical decision support is not used in computerized systems because they lack standards

b. The computer has virtually unlimited capacity for processing and storage of data

c. Clinical decision support is used in computers because they have consistent and standardized terminology

d. None of the above

Question 41.8: True or False? Is the computerized clinical decision support system in the EHR a component of the Meaningful Use certified EHR?

Question 41.9: How can patient decision support (PDS) support patient care?

a. There are no patient decision support systems

b. Patient decision support systems have minimal impact on patient care

c. PDS interventions decrease patients' knowledge and produce no input into the clinical decision support system

d. PDS interventions increase patients' knowledge, produce more accurate expectations, and lead to more conservative approaches to treatment that are more congruent with patients' informed preferences

Question 41.10: Where do the legal responsibility lie when computerized clinical decision support systems are used?

a. The legal responsibility for treatment and advice given to a patient rests with the clinician regardless of whether a CDSS is used

b. There is a shared responsibility between the vendor who developed the CDSS and the clinician

c. The sole legal responsibility for treatment and advice to patient rests with the vendor of the CDSS

d. There is a shared responsibility for treatment and advice to the patient with the hospital who purchased the CDSS and the vendor who provided it

ANSWERS AND EXPLANATIONS

Question 41.1: (d) All of the above.

Question 41.2: (c) a and b. (a) is a definition by the CDS/PI multistakeholder group and (b) is the definition by HIMSS.

Question 41.3: (c) Adoption of such tools will support clinical care decisions through the provision of additional and current information at the time and place of care delivery while final decision authority will remain with the vclinician.

Question 41.4: (a) Current evidence indicates that CDSS can improve patient care quality, reduce medication errors, minimize variances in care, improve guideline compliance, and promote cost savings.

Question 41.5: (b) Ease of use within existing workflow practice will determine the success of a CDSS.

Question 41.6: (a) Best knowledge available when needed, high adoption and effective use, and continuous improvement in knowledge.

Question 41.7: (b) The computer has virtually unlimited capacity for processing and storage of data.

Question 41.8: True. The Center for Medicare and Medicaid Programs provide financial incentives for the "meaningful use" (MU) of certified EHR technology to improve the quality of patient care and "inform clinical decisions at the point-of-care" (healthit.hhs.gov).

Question 41.9: (d) PDS interventions increase patients' knowledge, produce more accurate expectations, and lead to more conservative approaches to treatment that are more congruent with patients' informed preferences.

Question 41.10: (a) The legal responsibility for treatment and advice given to a patient rests with the clinician regardless of whether a CDSS is used.

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PART 7

Educational Applications

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Nursing Curriculum Reform and Healthcare Information Technology

• OBJECTIVES

1. Describe the background of and needs for curriculum reform in nursing education in the twenty-first century.
2. Discuss prior academic and other professional organizational efforts to transform nursing education with an emphasis on healthcare information technology.
3. List information technology competencies required by nurses with different levels of education.
4. Identify current national trends in nursing education associated with informatics.
5. Explain the content and process of the American Nurses Credentialing Center (ANCC) Nursing Informatics Certification examination.

• KEY WORDS

American Association of Colleges of Nursing (AACN) Essentials for Nursing
Electronic Health Records (EHR)
Healthcare Information Technology (HIT)
HITECH
Informatics competency
Knowledge, skills, and attitudes (KSA)
Nursing education curriculum
Nursing Informatics (NI)
Patient safety
Quality and Safety Education for Nurses (QSEN)
Technology Informatics Guiding Educational Reform (TIGER)

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip
When gaining attention and establishing common ground, ask questions of the class, such as the following: Should developing health information technology competencies be part of nursing education? What technology competencies have you developed in the last year? Should nurses be expected to develop technology competencies? Should nursing organizations be involved in recommending technology/informatics competencies?

For a WIIFM statement, say to the class, "This chapter will discuss the impact of healthcare information technology (IT) on current healthcare; Major efforts in nursing curriculum revisions; Nursing education reform in the current technology-rich environment; Major domains and attributes of HIT competencies needed for nursing students and practicing nurses in the current healthcare environment; and informatics competency for faculty members." As a nurse, it is important to understand the current changes in curriculum reform as influenced by the need for HIT competencies.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Background: Transformation of Healthcare Using Information Technology

1. **Overview**
   - **a.** Rapid advancement and policy-driven change in healthcare information technologies (HIT) in the twenty-first century offers nurses a great opportunity to augment their ability to manage patient information, generate knowledge, and provide quality care
     - **(1)** Since the Institute of Medicine (IOM) report, *To Err is Human* was released, a great deal of effort has been made to transform healthcare using information technologies
     - **(2)** In fact, in the current digital era, hospitals cannot be sustained without HIT, which allows healthcare providers to deliver safer and efficient care
     - **(3)** Healthcare ITs help clinicians manage a large volume of clinical data and access the most up-to-date evidence-based health information
     - **(4)** They also allow secure data exchange between patients, care providers, and organizations
     - **(5)** Credentialing organizations has also recognized the importance of HIT in healthcare organization
     - **(6)** In nursing, Magnet status recognition by the American Nurses Credentialing Center (ANCC) represents healthcare organizations' quality patient care, nursing excellence, and innovations in practice
     - **(7)** Hospitals can earn the recognition by meeting a set of standards for quality indicators and standards of nursing practice
     - **(8)** A strong presence and effective utilization of HIT is an essential component in the Magnet recognition process
   - **b.** Migration of paper-based health records to an electronic format has been a national priority for the current federal administration
     - **(1)** In an effort to make HIT become available to the majority of healthcare providers, the Office of the National Coordinator (ONC) funded several information technology (IT) training programs and regional extension centers
     - **(2)** Furthermore, Title XIII of the ARRA, Health Information Technology for Economic and Clinical Health Act (HITECH), authorized incentive payments through Medicare and Medicaid to clinicians and hospitals when they used electronic health records (EHRs) privately and securely to achieve specified improvements in care delivery ("*meaningful use*")
     - **(3)** Meaningful use (MU) is to
       - **i.** Improve quality, safety, efficiency, and reduce health disparities
       - **ii.** Engage patients and family
       - **iii.** Improve care coordination, and population and public health
       - **iv.** Maintain privacy and security of patient health information
   - **c.** MU criteria and objectives are phased out in three stages over a 5-year period (2011–2016)
     - **(1)** Stage 1 (2011–2012) focused on data capturing and sharing
     - **(2)** Currently, Stage 2 (2014) highlights the advancement of clinical processes
     - **(3)** This stage has a particular direct impact on patients and their caregivers as MU requires that providers give patients (>5% of those they see) access to their EHRs and use secure eMessaging to communicate with them
     - **(4)** To meet MU requirements, hospitals nationwide are implementing new information systems, including "tethered personal health records" (PHRs), which allow patients to access their EHRs and are integrated into "patient portals," secure Web sites providing health tools such as eMessaging or prescription refills
   - **d.** In order to provide optimal care in this rapidly changing and technology-laden healthcare environment, nurses must have a full understanding of the changes in healthcare and be properly prepared to use the available technological resources
   - **e.** This chapter will discuss
     - **(1)** The impact of healthcare information technology (IT) on current healthcare
     - **(2)** Major efforts in nursing curriculum revisions
     - **(3)** Nursing education reform in the current technology-rich environment
     - **(4)** Major domains and attributes of HIT competencies needed for nursing students and practicing nurses in the current healthcare environment
     - **(5)** Informatics competency for faculty members

> **Teaching Tip**
> Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Impact of Healthcare Information Technology on Current Healthcare

1. **Overview**
   - **a.** Many years ago, healthcare teams used to bring a cart full of paper-based patient medical records during rounds
     - **(1)** Physicians and nurses often furiously documented to-do lists on pieces of paper or in notebooks
     - **(2)** Recent advancements of HIT and the national push for using EHRs have revolutionized and impacted every aspect of healthcare delivery

Teaching Tip

Provide the example, for instance, currently most patients gather a significant amount of health information about their health online even before they meet with healthcare providers. When the patient goes to a clinic or hospital, he/she is admitted to a registration (or an admission) system before the patient sees his/her care providers. The data in those systems then are forwarded to other clinical systems, including electronic health records, laboratory and pharmacy systems, as well as other ancillary systems.

  - **(3)** Eventually the persons' health data in those systems are forwarded to finance systems and then sent to necessary insurance companies and other regulatory organizations
  - **(4)** Clinicians in the current era make rounds with a portable workstation on wheels (WOW) (a.k.a. computers on wheels [COWS]), which is connected to the hospitals' main EHR systems using a wireless connection
  - **(5)** They look for the most up-to-date evidence-based clinical information needed for the patient right at the bedside using various portable systems (iPad, tablet computers, personal digital assistant [PDA] devices)

b. In addition, Meaningful Use (MU) requires that eligible professionals and hospitals must meet the specific requirements for using EHRs to receive incentives and avoid penalties from Medicare and Medicaid

c. The current national HIT policies have had significant implications for healthcare providers, and the use of HIT systems in healthcare settings will continue to increase at a rapid pace

  - **(1)** Current HIT has already transformed various aspects of healthcare delivery, including regulations related to healthcare data and information
  - **(2)** For instance, the 1996 Health Insurance Portability and Accountability Act (HIPAA) was introduced to establish mechanisms to secure data stored in servers as well as during transmission to the other healthcare parties

d. In recent years, much has changed in healthcare since HIPAA was enacted over 15 years ago

  - **(1)** Thus, the HIPAA Omnibus Rule was introduced in 2013 to protect patient privacy and safeguard patients' health information in an ever-expanding digital age
  - **(2)** On the other hand, the demand for electronic health information exchange among care providers and care settings is growing along with national emphasis on the quality, safety, and efficiency of healthcare delivery

e. At the systems' level, healthcare providers must ensure the accuracy and completeness of data, as well as appropriate interoperability between the systems

  - **(1)** Implementation and maintenance of HIT are complex and dynamic processes and increasing numbers of HIT experts and clinicians are being involved in this process
  - **(2)** An enormous challenge for both healthcare organizations and educational institutions is the preparation of competent healthcare informaticians and clinicians competent in the use of health information technologies

f. With the national push, the adoption rates of these HIT technologies by clinicians and hospitals have been accelerated

  - **(1)** To achieve the successful adoption of HIT in healthcare, it is also critical to ensure clinicians' competency to use healthcare IT
  - **(2)** Nurses' competency for using HIT is particularly important because they are the largest group of direct healthcare providers in the United States, accounting for 19.6% of all healthcare workers in 2008 (approximately 3 million)
  - **(3)** In fact, nursing as a healthcare discipline has been ahead in terms of educating healthcare professionals who are specialized in healthcare IT
  - **(4)** For instance, nursing informatics (NI) was created as an area of graduate specialization at the University of Maryland School of Nursing (UM SON) in 1988, and NI was officially recognized as a specialty practice area by the American Nurses Association (ANA) in 1992
  - **(5)** Since then, informatics has become a core course for many baccalaureate programs, and many nursing schools have offered graduate degree programs focusing on nursing and healthcare informatics
  - **(6)** Many nursing schools, however, struggle with the inclusion of informatics competencies at all levels since many faculty members are unfamiliar with the informatics content

g. The advancement of available information communication technologies has also changed nursing education drastically

  - **(1)** Nursing schools teach their students using innovative technologies emphasizing evidence-based practice and problem-solving abilities
  - **(2)** Many nursing schools have high fidelity simulation labs, allowing students more opportunities to learn about the critical components of practical cases from school
  - **(3)** Stakeholders expect nursing students to be competent in using HIT when they arrive in practice settings
  - **(4)** Nursing as a profession has recognized the major reform of nursing education, and significant efforts are being made in many areas of the nursing domain, including revision of essentials for all levels of nursing education
  - **(5)** With these changes, informatics is now essential for all levels of nursing education

h. In addition to the reform in nursing education, the landmark document, *The Future of Nursing: Leading Change, Advancing Health*, by the Institute of Medicine examined the current nursing workforce and made critical recommendations to transform the nursing profession in an effort to improve the health of the U.S. population

  - **(1)** Those recommendations are focused on four areas, including an informatics field
    - Nurses should practice to the full extent of their education and training
    - Nurses should achieve higher levels of education and training through an improved educational system that promotes seamless academic progression

- Nurses should be full partners, with physicians and other healthcare professionals, in redesigning healthcare in the United States
- Effective workforce planning and policy making require better data collection and an improved information infrastructure

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Efforts in Nursing Curriculum Revisions

1. **Background**
   - **a.** An increased awareness of patient safety and the use of HIT in healthcare called for changes in the nursing curriculum
     - **(1)** The IOM report, *Health Professions Education: A Bridge to Quality*, is a result of a 2002 summit followed by the IOM's report, *Crossing the Quality Chasm*
     - **(2)** This interdisciplinary summit was held to discuss reforming education for health professionals to enhance quality and patient safety
     - **(3)** The report proposed five core competencies for healthcare professionals
       - *Provide patient-centered care—identify, respect and care about patients' differences, values, preferences, and expressed needs … and continuously advocate disease prevention, wellness, and promotion of healthy lifestyles, including a focus on population health*
       - *Work in interdisciplinary teams—cooperate, collaborate, communicate, and integrate care in teams*
       - *Employ evidence-based practice—integrate best research with clinical expertise and patient values for optimum care, and participate in learning and research activities to the extent feasible*
       - *Apply quality improvement—identify errors and hazards in care; understand and implement basic safety design principles … design and test interventions to change processes and systems of care, with the objective of improving quality*
       - *Utilize informatics—communicate, manage knowledge, mitigate error, and support decision making using information technology*
   - **b.** Since then, many efforts have been made by nursing professional organizations and the AACN to revise the nursing curriculum to be aligned with the IOM competencies
2. **Quality and Safety Education for Nurses (QSEN)**
   - **a.** The overarching goal of the three phases of the QSEN project, which was supported by the Robert Wood Johnson Foundation (RWJF), is to address the competencies necessary to continuously improve the quality and safety of the healthcare systems in which they work
     - **(1)** Phase I of the project identified six competencies that needed to be developed during pre-licensure nursing education

Teaching Tip
See Table 42.1.

     - **(2)** The group also proposed clarified competencies in the areas of knowledge, skills, and attitudes (KSAs)
   - **b.** Phase II work of QSEN was focused on competencies for graduate and advanced practice nurses (APNs)
     - **(1)** The QSEN faculty members collaborated with APNs who practiced in direct patient care and worked on the development of standards of practice, accreditation of educational programs, and certification
     - **(2)** The workgroups that participated in Phase II generated KSAs for graduate-level education
     - **(3)** Additionally, in Phase III, the AACN worked on developing the capacity of faculty engaged in pre-licensure nursing education to mentor their colleague faculty integration of the evidence-based content on the six QSEN competencies
   - **c.** Phase IV supports Institute of Medicine's recommendation increasing number of nurses with advanced degree
     - **(1)** These efforts are being led by the Tri-Council for Nursing, consisting of the
       - **i.** American Association of Colleges of Nursing
       - **ii.** National League for Nursing
       - **iii.** American Nurses Association
       - **iv.** American Organization of Nurse Executives (AONE)
   - **d.** The IOM/QSEN competencies and the pre-licensure KSAs are embedded in the new AACN Essentials for nursing education
3. **The American Association of Colleges of Nursing Essentials for Nursing**
   - **a.** In response to the urgent calls to transform healthcare delivery and to better prepare today's nurses for professional practice, the AACN convened a task force on essential patient safety competencies in 2006
     - **(1)** The taskforce recommended specific competencies that should be achieved by professional nurses to ensure high-quality and safe patient care
     - **(2)** Those competencies were identified under the following areas
       - **i.** Critical thinking
       - **ii.** Healthcare systems and policy
       - **iii.** Communication
       - **iv.** Illness and Disease Management
       - **v.** Ethics
       - **vi.** Information and healthcare technologies
     - **(3)** Since then, the AACN revised the Essentials of Baccalaureate Education for Professional Nursing Practice in 2008
   - **b.** In regards to the essentials for graduate programs, the AACN made a decision to migrate advanced practice nursing programs (APNs) from the master's level to the doctorate-level (doctor of nursing practice [DNP] program) by the year 2015

(1) Under this decision, many master's programs that prepare advanced practice registered nurses (APRNs) have already transitioned or in the process of making transition

(2) The Essentials of Doctoral Education for Advanced Nursing Practice were developed in 2006, and the informatics competency is one of the essentials for this education program

(3) This has a major impact on education at the graduate level

(4) Some non-APRN master's specialty programs (e.g., informatics, healthcare leadership and administration, and community-health nursing) still maintain the master's program

(5) The essentials for master's education were revised in 2011

c. Among various changes regarding essentials in nursing education since 2001, major emphasis has been on patient safety and healthcare IT

d. The major focus of this chapter is to discuss nursing curriculum from the context of HIT

Teaching Tip
Refer to Table 42.2 which focuses on AACN essentials in the area of information management and technology.

4. Technology Informatics Guiding Educational Reform (TIGER) Initiative

a. The recent Technology Informatics Guiding Educational Reform (TIGER) Initiative epitomizes nurses' efforts to translate high-level initiatives on nursing education reform to a practice level

(1) TIGER's aim is to fully engage practicing nurses and nursing students in the electronic era of healthcare

(2) TIGER's goal is to create and disseminate action plans that can be duplicated within nursing and other multidisciplinary healthcare training and workplace settings

(3) In Phase I of the TIGER summit, stakeholders from various fields, including nursing practice, education, vendors, and government agencies, participated in the discussions, and the TIGER team developed a 10-year vision and 3-year action plan for transforming nursing practice and education

(4) In Phase II, TIGER formalized cross-organizational activities/action steps into nine collaborative TIGER teams

i. Standards and Interoperability
ii. Healthcare IT National Agenda/HIT Policy
iii. Informatics Competencies
iv. Education and Faculty Development
v. Staff Development/Continuing Education
vi. Usability/Clinical Application Design
vii. Virtual Demonstration Center
viii. Leadership Development
ix. Consumer Empowerment/Personal Health Record

b. Currently TIGER is working on Phase III that integrates the TIGER recommendations into the nursing community as well as other disciplines across the continuum of care

c. Some of the important activities include the development and implementation of a Virtual Learning Environment Center (VLE) and developing another invitational summit

(1) The VLE is an interactive Web-based learning environment where the learners can develop knowledge and skills in the area of health information technology

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics Competencies for Practicing Clinicians

1. Overview

a. The essentials and competencies recommended by the IOM, AACN, QSEN, and TIGER address essential competencies that need to be addressed in educational programs

(1) A great deal of effort also has been made in developing more executable competency lists that can be used in practice settings

2. *American Nurses Association*

a. *Nursing Informatics: The Scope and Standard of Practice* addressed an NI-specific domain

(1) As discussed earlier, nursing informatics is an essential component for any nurse

(2) The competencies contained in the NI Scope and Standards matrix were categorized into three overall areas

i. Computer literacy
ii. Information literacy
iii. Professional development/leadership

(3) Computer literacy addresses competencies in the area of the psychomotor use of computers and other technological equipment

(4) Information literacy competencies are related to the ability to identify a need for information as well as the ability to find, evaluate, organize, and use the information effectively

(5) Professional development and leadership competencies address ethical, procedural, safety, and management issues for informatics solutions in nursing practice, education, research, and administration

(6) The competency framework includes all nurses with different levels of NI education (e.g., nurses with and without graduate-level NI specialty education) and different NI functional areas (e.g., analysis, consultation)

(7) The categories of educational and functional roles within the competency matrix include

- Beginning Nurse
- Experienced Nurse
- Informatics Specialist/Informatics Innovator
- Administration Analysis

  - Compliance and Integrity Management
  - Consultation
  - Coordination
  - Facilitation and Integration
  - Development
  - Educational and Professional Development
  - Policy Development and Advocacy
  - Research and Evaluation
  - Integrated Areas

b. The ANA's Nursing Informatics Scope and Standards Revision Workgroup is working on the revision of the current Nursing Informatics Scope and Standard of Practice

(1) The public comment period for the draft version closed on January 17, 2014

3. *TIGER Informatics Competencies Collaborative recommendations*

a. Upon extensive review of the literature, the TIGER Informatics Competency Collaborative (TICC) recommends specific informatics competencies for all practicing nurses and graduating nursing students

(1) The TIGER NI competencies model consists of the following three areas

i. Basic computer competencies

ii. Information literacy

iii. Information management

b. For the basic computer competencies, the TICC adopted the European Computer Driving License (ECDL) competencies and made its recommendations

(1) The European Computer Driving License (ECDL)/International Computer Driving License (ICDL) is an internationally recognized Information and Communication Technology and digital literacy certification

(2) The ECDL certification program was developed through the Task Force of the Council of European Professional Informatics Societies in 1995

(3) The new ECDL training program includes various modules and the certificate program is run worldwide through a network of Accredited Test Centers (ATCs)

(4) The specific recommendations made by the TICC were based on the old ECDL/ICDL Syllabus 5.0

4. *eHealth literacy*

a. One area that needs further discussion in the competencies addressed by the AACN and the TICC is eHealth literacy

(1) Norman and Skinner (defined eHealth literacy as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem"

(2) eHealth therefore requires combined literacy skills in several domains

(3) Norman and Skinner suggest six domains of eHealth literacy

i. Traditional literacy

ii. Information literacy

iii. Media literacy

iv. Health literacy

v. Computer literacy

vi. Scientific literacy

b. With the rapid growth in the use of eHealth at the global level, the concept of eHealth literacy has become more important than previous times

(1) eHealth literacy is often discussed at the consumers' level because consumers in the current age can access a large amount of health information online and many of them may not be prepared to locate the information they need or evaluate the quality of the information found from different sources

(2) Although nurses have much knowledge in general health than the public, eHealth literacy is also a concern for them

(3) Unlike many younger generations, nurses who did not grow up with technologies may spend less time exploring online health information and may be less familiar with search functions

(4) Considering the nurse's role as an educator for consumers and the heightened emphasis on evidence-based practice, nurses must be properly prepared to be eHealth literate

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Nursing Informatics as a Specialty Program at the Graduate Level

1. Overview

a. The ANA defines Nursing informatics (NI) as: "*a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge and wisdom in nursing practice. NI supports consumers, patients, nurses, and other providers in their decision-making in all roles and settings. This support is accomplished through the use of information structures, information processes, and information technology*"

b. The NI Scope and Standards of Practice clearly differentiates between informatics nurse specialists (INSs) and informatics nurses (INs)

(1) The INSs are those formally prepared at the graduate level in informatics and INs are generalists who have gained on-the-job training in the field but do not have the educational preparation at the graduate level in an informatics-related area

c. With the national emphasis on HIT education, various types of informatics-related educational programs are available at the graduate level, such as nursing informatics, healthcare informatics, bio-medical informatics, etc.

(1) Most informatics educational programs are moving toward online programs and/or hybrid (mainly online with some face-to-face classes) programs

- **(2)** The curriculum and credits vary a great deal depending on the program
- **(3)** The nursing informatics field also has unique characteristics

Teaching Tip
Provide the example, for instance, unlike other clinical nurses, the majority of the colleagues of the INSs are from other disciplines, such as computer science, information management, business (vendors), or administrators.

- **(4)** The roles the INSs assume also vary
- **(5)** In a 2009 Informatics Nurse Impact Survey ($N = 432$) conducted by the Healthcare Information and Management Systems Society (HIMSS), participants were asked to indicate the roles that nurses play with regards to IT
- **(6)** The findings showed the following results:
  - **i.** User education (93%)
  - **ii.** System implementation (89%)
  - **iii.** User support (86%)
  - **iv.** Workflow analysis (84%)
  - **v.** Getting buy-in from end users (80%)
  - **vi.** System design (79%)
  - **vii.** Selection/placement of devices (70%)
  - **viii.** Quality initiatives (69%)
  - **ix.** System optimization (62%)
  - **x.** System selection (62%)
  - **xi.** Database management/reporting (53%)
  - **xii.** (Note: only includes roles with greater than a 50% response rate)
- **(7)** In a subsequent 2011 Nursing Informatics Workforce Survey ($N = 660$) the majority of informaticians reported that their primarily work involves the
  - **i.** Area of systems implementation (57%)
  - **ii.** Systems development (53%)
  - **iii.** Followed by quality initiatives (31%)
- **(8)** Additionally, recent scientific discoveries in biomedical informatics and genomics, as well as the rapid growth in mHealth and eHealth have made a significant impact on healthcare informatics and the roles of nursing informatics specialists
- **(9)** These changes led to the revision of the ANA's Nursing Informatics Scope and Standards of practice
- **(10)** The revision also addresses other recent trends in technology, such as
  - **i.** Knowledge representation
  - **ii.** Tools to manage public health concerns
  - **iii.** Nanotechnologies

d. Considering these varying roles and areas of practice, it is logical that each program may have a different emphasis or strength

- **(1)** Assurance of quality standards of each program, however, is particularly concerning considering that there is no regulatory body or specialty organization that could set standards for educational programs in nursing informatics

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Certification in Nursing Informatics and Related HIT

1. Overview

- **a.** Currently the American Nurses Credentialing Center (ANCC), an accredited agency, offers the generalist nursing informatics certification (RN-BC)
  - **(1)** The minimum academic degree required to take the examination for this certification is a bachelor's or higher degree in nursing or a bachelor's degree in a relevant field. The test content outline for the nursing informatics certification examination can be found on ANCC's Web site
  - **(2)** The main content as of October 2014 includes
    - **i.** Foundations of Practice (71 items, 47.33%), which includes: the Scope and Standards of Informatics Practice, ethics, privacy and confidentiality, regulation and policy, management of data, healthcare industry trends, team building, conflict management, computer science, information science, cognitive science, nursing science, testing and evaluation methodologies, workflow processing, and theories that support the NI practice
    - **ii.** System Design Life Cycle (SDLC) (39 items, 26.00%) which includes the phases and tasks contained within the SDLC process along with the NI leadership role in managing the process
    - **iii.** Data Management and Healthcare Technology (40 items, 26.67%), which includes the current evidence about data to knowledge, data mining, and management
- **b.** As discussed previously, nursing informaticians' primary responsibilities vary a great deal and their work environments also differ (e.g., hospitals, vendors, consulting firms)
  - **(1)** Each job or setting may require a different certificate, such as project manager, information administrator
  - **(2)** Based on the 2011 HIMSS Nursing Informatics Workforce Survey, 19% of the respondents reported having a certificate in nursing informatics offered through the ANCC
  - **(3)** Many survey participants reported having a certificate(s) in other areas such as Certified Professional in Healthcare Information & Management System (CPHIMS) offered by HIMSS

Teaching Tip
Refer to Table 42.3 which summarizes information for selected certifications relevant to nursing informatics.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics Competencies for Faculty Members

1. Overview
    - **a.** In the past few years, there have been significant changes in nursing education
        - **(1)** Informatics competency has been addressed as a vital component in those changes
        - **(2)** IOM's Future of Nursing report also emphasized that efficient management of data and a robust informatics infrastructure are components in transforming the nursing profession
        - **(3)** Additionally, the current emphasis on meaningful use of EHR demands that nurses be competent in managing health data and information
        - **(4)** These changes also require a nursing faculty member to be competent in healthcare informatics
        - **(5)** The majority of current nursing faculty members also faces challenges in a way instruction is delivered
        - **(6)** Previously, most nursing education was delivered via classroom face-to-face settings
        - **(7)** However, with the exponentially growing information communication technologies, more instruction is being delivered using online format
        - **(8)** Current popularity with social networking programs has added additional complexity to the current online learning environment
    - **b.** To address these pressing needs, the National League for Nursing Issues call for Faculty Development and Curricular Initiatives in Informatics
        - **(1)** The RWJ also supported QSEN Phase IV specifically focusing on the goal of building capacity for nursing faculty members who are competent in the six QSEN competencies and to serve as peer mentor for other faculty members
        - **(2)** The AACN also plays a major role in building this capacity

Teaching Tip
Provide the example, in 2012, AACN sponsored the QSEN Nursing Informatics Deep Dive Workshop (DDW) in San Francisco Bay Area to build, develop, pilot, and evaluate a curriculum to improve the informatics knowledge and competencies of nursing faculty and health system educators who provide informatics training.

        - **(3)** All materials are available for use in the classroom through the QSEN Web site

2. **Simulation-based learning**
    - **a.** Use of high-fidelity simulation has become the gold standard in current nursing education
        - **(1)** The purpose of simulation in clinical settings is to replicate the important aspects of a clinical situation where students or clinicians can work to gain knowledge and experience
        - **(2)** Most nursing schools have multiple high-tech simulation labs, including high-fidelity simulators
        - **(3)** Those labs provide students with various simulated clinical settings

Teaching Tip
Provide the example, for instance, the University of Maryland School of Nursing has an entire simulated hospital in its school consisting of 24 labs including an operating suite, a community/home healthcare lab, and a diagnostic laboratory. To augment the simulation environment, some schools use an academic version of the EHR system.

    - **b.** Implementing the EHR in simulation labs allows students to have an opportunity to develop competencies in using HIT before they go into the clinical setting
        - **(1)** In addition, most EHRs have decision support systems which could significantly augment students' learning
        - **(2)** When schools implement these academic EHR systems, they must have a thorough plan and a multitude of resources

Teaching Tip
Provide the example, for instance, the school must have network infrastructures that can support the program, and have a designated project manager who is familiar with system deployment.

        - **(3)** There will be a great deal of work in developing use cases and building tables in the system, which also requires the clinical faculty members' participation
        - **(4)** It will be necessary to educate faculty members about the system since they must be competent to teach classes using the EHR
        - **(5)** Policies and procedures for using the system within the lab must be developed and clearly communicated to the students before the system is deployed
        - **(6)** The project manager must also consider various human factors and ergonomic issues, as well as system characteristics

3. **Interdisciplinary collaboration**
    - **a.** As emphasized by the NIH Roadmap initiative, the advancement of science can be made more effective by combining interdisciplinary knowledge and skills
        - **(1)** The recent NIH Clinical Translational Science Awards (CTSAs) have stimulated collaboration among disciplines and impacted both the clinicians' and researchers' paradigm in approaching research, practice, and education. Most of the changes have been mainly addressed in research and science fields thus far
        - **(2)** However, nursing education must embrace this initiative and prepare both our students and clinicians

Teaching Tip

One example of an approach could involve EHRs. EHRs can be an excellent communication and collaboration tool among interprofessional care providers in healthcare settings. Class projects and papers that incorporate data and information from EHRs can provide students the opportunity to exercise skill sets required for interdisciplinary collaboration which is an important competency within informatics. When an HIT system is implemented in a hospital setting, various professionals (e.g., IT professionals, clinicians, administrators, vendors, lawyers) have to work together as a team for a prolonged period, and the system often affects many departments and professionals concurrently. Upon the completion of system deployment, the systems will continue to require management and upgrades. Learning about interdisciplinary collaboration is critical in nursing education, and is becoming more important as technology becomes more advanced and as healthcare becomes more complex.

4. Informatics competencies for faculty members

  a. Innovative technologies in teaching and learning can produce optimal outcomes only when the instructors are competent in using those technologies

    (1) Previously we discussed the essential educational components needed to ensure nursing students' and practicing nurses' competencies in using healthcare information technologies and managing information

    (2) Current students who grow up with technologies often outpace their faculty members in using technologies

    (3) When faculty members need to teach an online class, they also have to learn about not only using technology, but also reorient themselves to a whole new way of teaching the content

Teaching Tip

Provide the example, for instance, the way that online students respond may be different from the students who take face-to-face classes. Faculty members must be properly supported to fully adopt the newest technologies (Griffin-Sobel et al., 2010). Some continuing education modalities for faculty members include half-day workshops, short refresher courses before the beginning of each semester, or online self-learning modules. If the school offers many online classes, a sufficient number of instructional design specialists should be a part of the staff.

  b. Faculty members who teach informatics must have a specific expertise in the field

    (1) With the heightened awareness of IT in healthcare technologies and the revised essentials for the baccalaureate and the DNP curriculums, increasing numbers of informatics classes are being required as core courses in nursing programs

    (2) The AACN's decision to migrate the ANP programs to the DNP level further accelerates this need

    (3) However, there is a significant shortage of faculty members who have an expertise in healthcare informatics and who can teach students

    (4) More doctorally prepared informatics faculty members with a proper education/training are needed in NI education

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

CONCLUSION

- Information technology has revolutionized current healthcare
- Consumers now can access enormous amounts of health information online even before they come to the hospital
- Healthcare providers and students can access evidence-based health information right at the bedside
- However, adoption of EHRs in healthcare has been slow, resulting in missed opportunities to provide safer and better quality care
- Recently, the government has made significant efforts to implement EHRs nationwide to deliver safer care and improving the efficiency of healthcare delivery
- These changes in healthcare delivery present multiple exciting opportunities for nursing education
- In addition, with the advancement information communication technology, face-to-face classes are being replaced by online classes, and high-tech and high-fidelity simulation-based nursing education has become a standard
- New generations of nursing students are expected to be informatics competent
- This chapter reviewed major HIT-related changes in our current healthcare system and efforts made by nursing organizations to reform the nursing curriculum
- In the past decade, the nursing profession has made great advancements in transforming nursing practice, education, and research
- Recent emphasis on interdisciplinary collaboration will further accelerate its progress

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe the background of and needs for curriculum reform in nursing education in the 21st century
- Discuss prior academic and other professional organizational efforts to transform nursing education with an emphasis on healthcare information technology
- List information technology competencies required by nurses with different levels of education
- Identify current national trends in nursing education associated with informatics
- Explain the content and process of the American Nurse Credentialing Center (ANCC) Nursing Informatics Certification examination

Teaching Tip

Ask the students to define the keywords

- American Association of Colleges of Nursing (AACN) Essentials for Nursing
- Electronic Health Records (EHR)
- Healthcare Information Technology (HIT)
- HITECH
- Informatics competency
- Knowledge, skills, and attitudes (KSA)
- Nursing education curriculum
- Nursing Informatics (NI)
- Patient safety
- Quality and Safety Education for Nurses (QSEN)
- Technology Informatics Guiding Educational Reform (TIGER)

CHAPTER REVIEW QUESTIONS

Question 42.1: What major reform area depicts the adoption of HIT in nursing education?

a. Introduction of informatics as an essential core course

b. The teaching of technologies for only industry

c. Use the skills laboratory to generate pain risk scale

d. Ensure that all nursing students are competent in safe care

Question 42.2: What other advancements has changed nursing education in the adoption of HIT?

a. Teaching software programming skills, using communication technologies, using innovative technologies for teaching evidence-based practices, and using technologies specific for teaching problem-solving abilities

b. Using high-fidelity simulation labs, teaching communication technologies, teaching software programming skills, and using technologies specific for teaching problem-solving abilities

c. Using innovative technologies for teaching evidence-based practices, teaching software programming skills, using technologies specific for teaching problem-solving abilities, and using high-fidelity simulation labs

d. Using high-fidelity simulation labs, using communication technologies, using innovative technologies teaching evidence-based practices, and using technologies specific for teaching problem-solving abilities

Question 42.3: Which area of the four recommended in the IOM report on the Future of Nursing Education Change, Advancing Health focused on informatics?

a. Nurses should practice to the full extent of their education and training

b. Effective workforce planning and policy-making required better data collection and an improved information infrastructure

c. Nurses should be full partners, with physicians and other healthcare professionals, in redesigning healthcare in the United States

d. Nurses should achieve higher levels of education and training through improved educational system that promoted seamless academic progression

Question 42.4: What are the five core competencies for healthcare professionals recommended at the IOM Committee on Health Education Profession Summit in 2002?

a. Provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, utilize informatics, and utilize simulation technologies

b. Work in interdisciplinary teams, employ evidence-based practice, apply quality improvement, utilize informatics, and utilize simulation technologies

c. Employ evidence-based practice, apply quality improvement, utilize informatics, utilize simulation technologies, and provide patient-centered care

d. Utilize informatics, provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, and apply quality improvement

Question 42.5: What is a major core competency for a healthcare professional to improve the quality and safety of healthcare systems as indicated in the QSEN project funded by RWJF?

a. Provide patient-centered care

b. Research healthcare theories

c. Implement a quality improvement indicator

d. Utilize nursing practice skills

Question 42.6: What six specific competencies were recommended, by the Task Force convened by the AACN in 2006, that should be achieved by professional nurses to ensure high-quality and safe patient care?

a. Communication, ethics, healthcare systems and policy, illness and management, nursing language, and critical thinking

b. Critical thinking, ethics, healthcare systems and policy, illness and management and information, nursing terminology, and healthcare technologies

c. Critical thinking, communication, ethics, healthcare systems and policy, illness management and information, and healthcare technologies

d. Critical thinking, ethics, healthcare systems and policy, illness and management, communication and nursing language

Question 42.7: What are the competencies outlined by the ANA in its NI Scope and Standards of Practice?

a. They focus on the competencies by educational preparation level of the nursing students

b. They are categorized by computer literacy, information literacy, and professional developments

c. They are categorized by the experiences level and specialty of the nurses—beginning, novice, experienced, administrative, etc.

d. They focus on the competencies based on several nursing researchers, for example Staggers

Question 42.8: Even though the Nursing Informatics Educational Programs vary, the roles of nursing informatics nurses in HIT in hospitals, healthcare facilities, or commercial vendors also vary. According to the HIMSS Survey in 2009 the:

a. The major roles of nursing informatics experts are in online nursing education, in-service education, and/or user education

b. The major roles of nursing informatics experts are in system implementation, system development, and quality initiatives

c. The major role of nursing informatics experts are in the areas of research, terminology development, and care planning design

d. The major roles of nursing informatics experts are in federal, state, and local HIT policy and HIT standards development

Question 42.9: What is the major purpose of the use of high-fidelity simulation-based learning which has become the gold-standard in current nursing education?

a. To replicate the important aspects of clinical situation to gain knowledge and experience

b. To educate faculty in high-fidelity simulations for home health HIT systems

c. To educate faculty in primarily clinical situations for the OR

d. To educate faculty about the various inpatient hospital departments

Question 42.10: What best represents continuing education modalities for teaching faculty NI?

a. NI workshops, NI textbooks, short refresher NI courses, and online self-learning modules

b. Short refresher NI courses, NI workshops, online self-learning modules, and PoC lectures

c. Online self-learning modules, PoC lectures, NI workshops

d. NI lab exercises, PoC lectures, short refresher courses, and NI workshops

ANSWERS AND EXPLANATIONS

Question 42.1: (a) Introduction of informatics as an essential core course. Many events have occurred to introduce informatics as a core course in the nursing curriculum. The first university was the UMD in 1988 to introduce nursing informatics as an area of graduate specialization.

Question 42.2: (d) Using high-fidelity simulation labs, using communication technologies, using innovative technologies teaching evidence-based practices, and using technologies specific for teaching problem-solving abilities. The advancement of available information communication technologies has also changed nursing education drastically. Nursing schools can now teach their students using innovative technologies emphasizing evidence-based practice and problem-solving abilities.

Question 42.3: (b) Effective workforce planning and policymaking required better data collection and an improved information infrastructure. The landmark document by the IOM cited above examined the current nursing workforce and made critical recommendations to transform the nursing profession in an effort to improve the health of the US population. Those recommendations are focused on four areas, one of which addressed the informatics field above.

Question 42.4: (d) Utilize informatics, provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, and apply quality improvement. The IOM report in 2001, Crossing the Quality Chasm (Committee on Quality of Healthcare in American) is a result of a 2002 summit. This interdisciplinary summit was held to discuss reforming education for health professionals to enhance quality and patient safety. The report proposed five core competencies for healthcare professionals listed above.

Question 42.5: (a) Provide patient-centered care. The Quality and Safety Education for Nurses (QSEN) project supported by RWJF was to address the competencies necessary to continuously improve the quality and safety of the healthcare systems in which they work. The first QSEN competency for nurse was patient-centered care.

Question 42.6: (c) (1) Critical thinking, (2) communication, (3) ethics, (4) healthcare systems and policy, (5) illness management and information, and (6) healthcare technologies. In response to the urgent calls to transform healthcare delivery and to better prepare today's nurses for professional practice, the CAN convened the Task Force which recommended the specific competencies essential in the area of information management and technology and which since has been updated in 2011.

Question42.7: (b) They are categorized by computer literacy, information literacy, and professional developments. The competencies contained in the NI Scope and Standards were categorized into the three overall areas listed above. Computer literacy addresses competencies in the psychomotor use of computers and other technological equipment. Information literacy competencies are related to the ability to identify a need for information as well as the ability to find, evaluate, organize, and use information effectively. Professional development and leadership competencies address ethical, procedural, safety, and management issues for informatics solutions in nursing practice, education, and administration.

Question 42.8: (b) The major roles of nursing informatics experts are in system implementation, system development, and quality initiatives. The Healthcare Information and Management System Society (HIMSS) was asked to indicate the roles that nurses play with regard to IT. The Nursing Informatics Workforce Survey conducted in 2009 by HIMSS showed that the majority of informaticians reported their primarily work involved the three areas listed above.

Question 42.9: (a) To replicate the important aspects of clinical situation to gain knowledge and experience. Most nursing schools have multiple high-tech simulation labs including high-fidelity simulators. Those labs provide students with various simulated clinical settings such as a simulated hospital in the SON including operating suite, a community home healthcare lab, and a diagnostic laboratory. Also to augment the simulation environment some schools use an academic version of the EHR system. Implementing the EHR in simulation labs allows students to have an opportunity to develop competencies using HIT before they go into the clinical setting.

Question 42.10: (a) NI workshops, NI textbooks, short refresher NI courses, and online self-learning modules. The competency of faculty is equally critical as students. Current students who grow with technologies often outpace their faculty members in using technologies. When faculty members need to teach online class, they have to learn about not only using the technology, but also reorient themselves to a whole new way of teaching content.

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The TIGER Initiative

• OBJECTIVES

1. Discuss the TIGER Initiative agenda.
2. Describe the evolution the TIGER Initiative.
3. Describe examples of how the TIGER Initiative has impacted practice and education reform by providing resources to advance the integration of technology into practice, education, and consumer engagement.

• KEY WORDS

Decade of Healthcare Technology
Grassroots effort
Technology Informatics Guiding Education Reform
Invitational Summit
Collaborative Workgroups
Virtual Learning Environment
The TIGER Initiative Foundation

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Have you utilized a virtual learning environment? Can you give an example? Why would a virtual learning environment be important to nursing? Are you familiar with TIGER? What has been the impact of TIGER on nursing? What is meant by a grassroots effort? Have you been involved in a grassroots effort? Can you give an example?

For a WIIFM statement, say to the class, "This chapter describes a wonderful story of what can occur when individuals committed to a common cause come together and take action. The best part is that this story has no ending … the roots of the **TIGER (Technology Informatics Guiding Education Reform) Initiative** is already having a ripple effect across the healthcare industry and the work that is being accomplished through TIGER is now being cited, as it will continue to be in the future, as being a significant catalyst for change in addressing the call for healthcare transformation by the Institute of Medicine, *Crossing the Quality Chasm and Health Professions Education: A Bridge to Quality*. These two landmark reports addressed major changes needed for both practicing clinicians and educators. For practicing clinicians, the first report notes that, 'The use of tools to organize and deliver care has lagged far behind biomedical and clinical knowledge. Carefully designed, evidence-based care processes, supported by automated clinical information and decision support systems, offer the greatest promise of achieving the best outcomes from care for chronic conditions. Systems must facilitate the application of scientific knowledge to practice and provide clinicians with the tools and supports necessary to deliver evidence-based care consistently and safely.' For educators, the second report called for new ways for health professions to be educated and it identified five core competencies for all healthcare professionals: provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, apply quality improvement, and utilize informatics. Both of these reports, along with the federal efforts described below to address the need for widespread health information technology adoption, were the catalysts for the beginning of the TIGER Initiative, and its continued evolution." As a nurse, it is important to understand the TIGER initiative.

Class Preparation

1. Review the references listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter topic

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
    - **a.** This chapter describes a wonderful story of what can occur when individuals committed to a common cause come together and take action
        - **(1)** The best part is that this story has no ending … the roots of the **TIGER (Technology Informatics Guiding Education Reform) Initiative** is already having a ripple effect across the healthcare industry and the work that is being accomplished through TIGER is now being cited, as it will continue to be in the future, as being a significant catalyst for change in addressing the call for healthcare transformation by the Institute of Medicine
        - **(2)** These two landmark reports addressed major changes needed for both practicing clinicians and educators
        - **(3)** For practicing clinicians, the first report notes that, "The use of tools to organize and deliver care has lagged far behind biomedical and clinical knowledge
        - **(4)** Carefully designed, evidence-based care processes, supported by automated clinical information and decision support systems, offer the greatest promise of achieving the best outcomes from care for chronic conditions
        - **(5)** Systems must facilitate the application of scientific knowledge to practice and provide clinicians with the tools and supports necessary to deliver evidence-based care consistently and safely"
        - **(6)** For educators, the second report called for new ways for health professions to be educated and it identified five core competencies for all healthcare professionals: *provide patient-centered care, work in interdisciplinary teams, employ evidence-based practice, apply quality improvement, and utilize informatics*
        - **(7)** Both of these reports, along with the federal efforts described below to address the need for widespread health information technology adoption, were the catalysts for the beginning of the TIGER Initiative, and its continued evolution

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Decade of Healthcare Technology (2014)

1. **National HIT Agenda**
    - **a.** In early 2004, US President George W. Bush declared the *Decade for Health Information Technology* and created the Office of the National Coordinator of Health Information Technology
        - **(1)** In May 2004, Secretary of Health and Human Services, Tommy Thompson, appointed Dr. David Brailer as the first National Health Information Technology Coordinator
        - **(2)** This was an exciting time for health professions committed to the transformational role health information could play in substantial improvements in safety, efficiency, and other health reform efforts
        - **(3)** In July 2004, Brailer convened the first national health information technology summit in Washington, DC and launched the strategy to give US citizens the benefits of an electronic health record within a 10-year timeframe
2. **Where is nursing?**
    - **a.** A very important observation was made at this first Office of the National Coordinator (ONC) event
        - **(1)** The nation's 3 million nurses who comprise up to 55% of the workforce were not represented and/or clearly identified as an important integral part of achieving the ONC vision and strategy
        - **(2)** It left many begging the question, "Where is nursing?"
        - **(3)** There was also a keen awareness that without nursing engagement not only was the National HIT Agenda at risk, but nursing would be at risk by not acting on a wonderful opportunity to significantly advance the agenda to transform practice and education with evidence and informatics
        - **(4)** Kotter, in his books, *Leading Change* and *A Sense of Urgency*, describes the impact that having *a true sense of urgency* can have on large-scale effective change
        - **(5)** When the sense of urgency is as high as possible and among as many people as possible, the greater the successes of leading transformational change efforts will be
        - **(6)** Leaders in nursing realized the sense of urgency to begin a grassroots effort following this initial HIT summit and moved to birth a movement that would assure nursing was at the table and were key stakeholders/advocates as health information technologies were integrated into the nation's healthcare delivery systems and academic programs

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Birth of the TIGER Initiative (2005)

1. **Challenges and opportunities facing nursing**
    - **a.** The grassroots leadership efforts began to take action and network with others to determine first steps and gather key individuals to attend the first TIGER meeting
        - **(1)** The first official TIGER gathering was held on January 14, 2005 hosted by Johns Hopkins University School of Nursing
        - **(2)** A diverse group of nursing leaders across the country engaged in conversation about the skills and knowledge

needed by the healthcare provider/nurse of the 21st century

- **(3)** Trends and patterns on topics such as
  - **i.** Basic skills
  - **ii.** Critical thinking
  - **iii.** Change management
  - **iv.** Evidence-based practice
  - **v.** Knowledge-workers
  - **vi.** Curriculum integration
  - **vii.** Professional practice
  - **viii.** Interdisciplinary collaborative practice
  - **ix.** Leadership
  - **x.** Global military systems
  - **xi.** National standards
  - **xii.** Clinical documentation
  - **xiii.** Public policy
  - **xiv.** And more emerged as current challenges and opportunities facing nurses during this informatics revolution
- **(4)** It was identified that the opportunity was more than just tackling "informatics"—the focus needed to be more on quality care and evidence-based care
- **(5)** There was a unique window of opportunity for TIGER to build on the successes of informatics and to connect more key stakeholders in an effort to move a bigger whole forward in guiding true transformation
- **(6)** Lastly, TIGER needed to tap the power of the 3 million nurses in the workforce by finding ways of getting many of them engaged to move the TIGER agenda forward
- **(7)** It was decided, at that time, to hold an invitational summit in an effort to bring together a diverse group of
  - **i.** Stakeholders (professional organizations, governmental organizations
  - **ii.** Technology vendors
  - **iii.** Informatics specialists, etc.) to further advance the sense of urgency and action needed to assure that nurses were able to provide safe, efficient, and patient-centered care to all
  - **iv.** At that time, questions were raised concerning whether or not the summit should include all disciplines to help meet the IOM aims and competencies
  - **v.** While this was recognized as being very important, there was consensus that it was critical to begin with moving the nursing workforce forward first and then to expand out as recommendations were made from the summit

2. Setting the vision for TIGER

- **a.** The following vision statement and expected outcomes were developed to guide the early stages of the TIGER Initiative
  - **(1) TIGER vision**
    - **i.** Allow informatics tools, principles, theories, and practices to be used by nurses to make healthcare safer, effective, efficient, patient-centered, timely, and equitable
    - **ii.** Interweave enabling technologies transparently into nursing practice and education, making information technology the stethoscope for the 21st century
  - **(2) TIGER expected outcomes**
    - **i.** Publish a summit report, including summit findings and exemplars of excellence
    - **ii.** Establish guidelines for organizations to follow as they integrate informatics knowledge, skills, and abilities into academic and practice settings
    - **iii.** Set an agenda whereby the nursing organizations specify what they plan to do to bridge the quality chasm via information technology strategies

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The TIGER Summit (2006)

1. The invitational summit

- **a.** To prepare for the invitational summit, a program committee was formed that planned for over a year for the event
  - **(1)** A fundraising committee was also formed to secure funds to support the TIGER Summit and expected outcomes
  - **(2)** Over 25 diverse sponsors made contributions to the summit and grants were received from the
    - **i.** Agency for Healthcare Research and Quality (AHRQ)
    - **ii.** Robert Wood Johnson Foundation (RWJF)
    - **iii.** National Library of Medicine (NLM)
- **b.** The invitational summit was held at the end of October in 2006 and was hosted by the Uniformed Services University of the Health Sciences in Bethesda, MD
  - **(1)** Over 100 leaders from the nation's
    - **i.** Nursing administration
    - **ii.** Practice
    - **iii.** Education
    - **iv.** Informatics
    - **v.** Technology organizations
    - **vi.** Governmental agencies
  - **(2)** And other key stakeholders participated in the very interactive 2-day summit
  - **(3)** External facilitators from Bonfire Communications created an open-space experience that included
    - **i.** Small and large group dialogues
    - **ii.** Unique graphic art to capture the vision, outcomes of the dialogues, and action plans
    - **iii.** The use of an audience response system (ARS) to capture current realities as well as gain consensus
  - **(4)** To stimulate imagination and thinking, a Gallery Walk experience was done on Day One in which participants were able to "walk through" and review cutting-edge technology and clinical decision support systems being utilized in healthcare environments today

- **(5)** The TIGER Executive and Program Committee felt that it was important to build on some national exemplars in practice and education today
- **(6)** A total of seven national exemplars were shared with time for questions and answers from participants

2. 10-Year vision and 3-year action steps

- **a.** The entire summit was focused on creating movement toward consensus on a 10-year vision and a 3-year action plan
  - **(1)** The 10-year vision was more clearly evolved by doing collective work around seven pillars and then content streaming the patterns and most salient points
  - **(2)** With the seven pillars and rich content as its framework, a 3-year action plan was identified to achieve the 10-year vision of evidence and informatics transforming practice and education
  - **(3)** This required intense group work and collaboration among the participants
- **b.** The last Call for Action before participants left the summit was for each leader of a participating organization to identify definable action plan goals that they could take back to their organization
  - **(1)** Each participant signed the "TIGER Commitment Wall" to show their commitment to the TIGER Vision and Action Plans as well as to continue to promote and engage others in the TIGER Initiative
- **c.** Following the TIGER Summit a Web site was established to record the several events and actions to the TIGER Summit as well as to post new information
  - **(1)** In addition, the summit report *Evidence and Informatics Transforming Nursing: 3-Year Action Steps toward a 10-Year Vision* was developed and widely distributed via a published report as well as via a pdf download from the Web site
  - **(2)** The report provided a summary of the summit as well as recommendations for specific stakeholder groups
    - **i.** Professional Nursing Organizations
    - **ii.** Academic Institutions, Information Technology
    - **iii.** Government and Policy Makers
    - **iv.** Healthcare Delivery Organizations
    - **v.** Health Information Management Professionals/ Health Science Libraries
  - **(3)** Leaders from five major nursing organizations including the
    - **i.** American Colleges of Nursing
    - **ii.** American Nurses Association
    - **iii.** American Organization of Nurse Executives
    - **iv.** National League for Nursing
    - **v.** Sigma Theta Tau International—affirmed their commitment and need for the profession to continue to support the TIGER Initiative

3. The TIGER Collaborative Workgroups (2007–2008)

- **a.** Several months after the summit, and after several follow-up meetings with the TIGER Executive Steering Committee, it was decided to move into phase II of TIGER
  - **(1)** Building off the summit pillar and action plans, nine key collaborative were identified to dig deeper and tap a broader engagement from the nursing community to address the recommendations made at the summit
  - **(2)** Each collaborative was assigned coleaders to facilitate the workgroup and as well as write a final report and share the workgroup final findings and recommendations

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The TIGER Initiative Today (2009–2014)

1. The TIGER Initiative Foundation

- **a.** The past 5 years have continued to demonstrate continuous momentum toward the 10-year vision
  - **(1)** The years of 2009–2010 kept critical TIGER leader volunteers busy with sharing the collaborative reports as well as seeking new opportunities for further TIGER engagements with key stakeholder, nursing, and other interdisciplinary professional organizations
  - **(2)** During this time the foundation was being laid for building out a Virtual Learning Environment (VLE) including collaborating partners such as the National Library of Medicine and the Uniform Services University of the Health Sciences
  - **(3)** In July 2011 the TIGER Initiative Foundation was formed as a 501(c) (3) organization operating for charitable, educational, and scientific purposes
  - **(4)** This was a significant milestone for TIGER as it provided a structure to strategically grow TIGER including having a dedicated Senior Director and full Board of Directors
  - **(5)** A new TIGER Web site was established that has been a central hub for connecting TIGERs and sharing the many TIGER activities that occur with the more than 1500 volunteers that have been engaged with the TIGER Initiative

2. Refreshed TIGER vision and mission

- **a.** The first priority of the new Board of Directors was to reevaluate the TIGER vision and mission
  - **(1)** The new TIGER Vision is *to enable nurses and interprofessional colleagues to use informatics and emerging technologies to make healthcare safer, more effective, efficient, patient-centered, timely and equitable by interweaving evidence and technology seamlessly into practice, education, and research fostering a learning healthcare system* and the new TIGER Mission statement is *Advancing the integration of health informatics to transform practice, education and consumer engagement*

  - **(2)** The board also focused on a strategic priority to launch the TIGER VLE. Committees were also formed to focus on Education, Foundation Development, and Interdisciplinary and Consumer Engagement

3. Virtual Learning Environment (VLE)

- **a.** In February 2012 the TIGER Initiative Foundation VLE was officially launched
  - **(1)** The VLE provides an interactive Web-based learning opportunity which includes information about HIT and related topics for healthcare professionals and consumers
  - **(2)** The Web-based format provides dynamic and real-time information on topics such as
    - **i.** Electronic health records
    - **ii.** Usability
    - **iii.** Clinical decision support
    - **iv.** Health information exchange
    - **v.** Care coordination
    - **vi.** Meaningful use
    - **vii.** Standards and interoperability
    - **viii.** Consumer health information
    - **ix.** Mobile health
    - **x.** Privacy and security
    - **xi.** Health IT and nursing practice
    - **xii.** Many other related topics
  - **(3)** It also provides the opportunity for sponsors to share their contributions of integrating health informatics to transform practice, education, and consumer engagement via white papers, demonstrations, videos, and other educational assets
  - **(4)** The VLE enables users to download information into a virtual briefcase as well as utilize social media and chat rooms to engage with other TIGERs
  - **(5)** Currently there are over 400 individuals across multiple countries that have active TIGER VLE memberships and two universities are using the VLE to augment classroom curriculum
  - **(6)** There is great opportunity for interprofessional teams in practice and academia to leverage the TIGER VLE to learn and develop knowledge and skills regarding technology and informatics to better integrate into their daily work
  - **(7)** A good case has been made for why faculty need access to the VLE with examples of how to find valuable resources and ways to engage with students using the Web-based platform
  - **(8)** A new component being added to the Faculty Development Learning Community is a series of curriculum guides that tie Outcome Competencies, Content, Learning Activities/Resources and Teaching Strategies for specific topic such as Use of Technology to Support Safety and Quality Care Delivery, Clinical Decision-making, Communication and Documentation of Interprofessional Care, and Consumer Engagement
  - **(9)** The last one is related to Involvement with Systems Development Life Cycle
  - **(10)** All of the curriculum guides are crosswalked to
    - **i.** The AACN's Essentials of Baccalaureate Education for Professional Nursing
    - **ii.** TIGER Competencies
    - **iii.** QSEN
    - **iv.** The Canadian's Nursing Informatics Entry-into-Practice Competencies for Registered Nurses
  - **(11)** The TIGER VLE can be accessed via the Web site to become a member and get access to the plethora of great learning materials and interactive learning venues

4. International and interprofessional expansion

- **a.** Two strategic priorities the TIGER Initiative Foundation is focused on for the next few years are increasing the TIGER vision/mission across international borders and to more actively engage interprofessional colleagues in education and practice
  - **(1)** The first step at international expansion was at the NI2012 Conference in Montreal, Canada, where the International Committee was officially launched with five countries including
    - **i.** Brazil
    - **ii.** United Kingdom
    - **iii.** Taiwan
    - **iv.** Germany
    - **v.** Canada
  - **(2)** The TIGER International Committee led a TIGER session at MedInfo 2013 in Copenhagen which generated much interest from other countries to become engaged
  - **(3)** Recently 28 new countries have been invited to join the TIGER International Committee to share learning needs, synergies, and engage in the VLE
  - **(4)** There is a growing momentum in healthcare today on creating true interprofessional education and practice environments and it is critical that leaders in informatics to be aware of this momentum
  - **(5)** The TIGER Initiative Foundation has committed to transitioning to an Interprofessional Board of Directors in the future and to include other healthcare professions in TIGER activities and the TIGER VLE learning environment

5. The Leadership Imperative Report

- **a.** At the writing of this chapter, The TIGER Initiative Foundation is preparing to launch another Collaborative Report
  - **(1)** It was recognized at the TIGER Summit the significance of leadership to be engaged and support the vision and mission of TIGER which resulted in the TIGER Revolutionary Leadership Report
  - **(2)** The new leadership collaborative report *The Leadership Imperative: TIGER's Recommendations for Integrating Technology to Transform Practice and Education* resulted from the continued recognition of how critical leadership is to fulfill the TIGER vision and mission and to *lead the way* by providing transformational

leadership that drives and executes the transformation of healthcare

(3) The report addresses the need to focus on both practice and technology as well as provides valuable information, tools, and resources for leaders to access and utilize as they integrate technology into practice and education

(4) The report will be launched at the TIGER Institute at HIMSS 2014 and will be available on the TIGER Web site

6. Once a TIGER always a TIGER

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

BRIEF SUMMARY AND CONCLUSION

- The sign of significant changes to come was palpable back in 2004 as our nation began to address healthcare reform by announcing this would be the decade for healthcare technology
- A great sense of urgency to set a vision and course of action for nurses to lead and, in turn, engage *all* nurses was the beginning of Technology Informatics Guiding Education Reform; the TIGER acronym was perfect as hundreds of nurses launched into action
- The grassroots effort took root and emerged into an innovative social disruption that continues to grow
- Many TIGERS have shared that the sense of collaboration and teamwork has been an amazing experience
- The number of volunteer hours has been simply astounding! Today TIGER has also expanded its presence on social media with a TIGER Facebook and TIGER Twitter @AboutTIGER
- The timing of TIGER is even more significant now with the passing of the 2009 American Recovery and Reinvestment Act (ARRA) and the phased mandate for “Meaningful Use” of the electronic health records
- The development of the TIGER Initiative Foundation has provided a solid home for TIGER that has resulted in the launching of an exciting TIGER VLE that helps to provide tools and resources that support many of the ANA Certification topics such as human factors, information technology, information management, professional practice, models and theories, and management and leadership
- Expanding TIGER beyond international boundaries and interprofessional silos will also help to spread the vision and take the actions necessary to integrate evidence and technology informatics into our daily work to make healthcare safer, effective, efficient, patient-centered, timely, and equitable

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Discuss the TIGER Initiative agenda
- Describe the evolution the TIGER Initiative
- Describe examples of how the TIGER Initiative has impacted practice and education reform by providing resources to advance the integration of technology into practice, education, and consumer engagement

Teaching Tip
Ask the students to define the keywords

- Decade of Healthcare Technology
- Grassroots effort
- Technology Informatics Guiding Education Reform
- Invitational summit
- Collaborative Workgroups
- Virtual Learning Environment
- The TIGER Initiative Foundation

CHAPTER REVIEW QUESTIONS

Question 43.1: What were the most influential catalysts that created TIGER (Technology Informatics Guiding Education Reform)?

a. IOM reports on the major changes needed for both practicing clinicians and educators and federal efforts to address the need for widespread HIT adoption
b. An NCVHS report on HIT policies and the ONC initiative for HIT standards
c. Federal efforts promoting MU and the ANA approval of NI as a new nursing specialty
d. Idea conceived by a team of innovative NI experts at a meeting and a federal effort to support NI education

Question 43.2: What was the best leadership effort that originally created the TIGER educational initiative?

a. Offered workshop to educate key nursing students to move the initiative forward
b. Engaged nursing faculty to get involved in TIGER
c. Convened a meeting of NI leaders and educators to discuss NI challenges
d. Held a summit to bring together nursing stakeholders with the ANA and NLN

Question 43.3: What was one of the visions in the early stages of TIGER?

a. Provide informatics tools for safe nursing practice
b. Interweave enabling technologies into nursing practice and education
c. Establish guidelines for skill development of healthcare
d. Urge nursing organizations to promote healthcare practices

Question 43.4: What was required of the first TIGER Summit participants to take back to their organizations before they left?

- **a.** Had to identify a definable action plan goal True ___ X False ___
- **b.** Had to show commitment to the TIGER Vision and Action Plans True ___ X False ___
- **c.** Had to show a continued commitment to promote and engage others in the TIGER Initiative True ___ X False ___
- **d.** Had to sign the "TIGER Commitment Wall" True ___ X False ___
- **e.** Had to generate funds to keep TIGER alive True ___ False ___X

Question 43.5: What did the TIGER Summit report provide?

- **a.** A summary of the summit participants as well as recommendations for NI students
- **b.** A summary of the summit's seven pillars as well as recommendations for specific stakeholders
- **c.** A summary of "who is doing what" as well as recommendations for specific stakeholders
- **d.** A report on the recommended competences of TIGER members on Nursing Informatics

Question 43.6: What was the action proposed by the TIGER Executive Steering Committee for the TIGER Phase II?

- **a.** Nine key collaborators were selected to address the summit recommendations by investigating further and preparing a final report on its purpose, outcomes, and access
- **b.** Seven key leaders representing the seven pillars identified at the summit were selected to write a report on their TIGER accomplishments
- **c.** The Executive Steering Committee identified and proposed to hold a TIGER Summit II
- **d.** The summit participants were followed-up with a survey of successes and failures

Question 43.7: In the last 5 years what was the major initiative for the TIGER movement?

- **a.** The creation of a Web site and Facebook account for connecting TIGERs together
- **b.** The creation of a Virtual College with courses on TIGER initiatives
- **c.** The creation of a Virtual Learning Environment (VLE) as a charitable organization
- **d.** The development of workshops and Webinars for TIGER members

Question 43.8: What is the value of the TIGER's Virtual Learning Environmen t's (VLE) Web-based platform? Answer each statement as "True' or 'False."

- **a.** It provides a dynamic and real-time information on topics such as electronic health records True ___ X False ___
- **b.** Opportunity for sponsors to discuss contributions of nurses True ___ X False ___
- **c.** Allows users to download information into a virtual briefcase True ___ X False ___
- **d.** Allows users to engage in social media and chat rooms on amazon.com True ___ False ___ X
- **e.** Enables interprofessional teams in practice and academia to leverage TIGER to learn True ___ X False ___

Question 43.9: What are the two strategic priorities for the TIGER Initiative Foundation proposed expansion?

- **a.** Increase vision/mission across international borders and more actively engage in interprofessional colleagues in education and practice
- **b.** Increase vision/mission across international borders and more actively engage in nursing colleagues in education and practice
- **c.** Become more actively engaged in interprofessional colleagues and increase vision/mission in Canada
- **d.** Increase vision/mission in the United States and more actively engage in interprofessional colleagues in education and practice

Question 43.10: What best describes TIGER's vision in its new collaboration report?

- **a.** It focuses on healthcare practices in "meaningful use"
- **b.** It provides competencies and educational requirements for the different levels of NI education
- **c.** It provides information, tools, and resources for leaders to access and utilize as they integrate technology into practice and education
- **d.** Critical recognition of medical leadership is transforming healthcare

ANSWERS AND EXPLANATIONS

Question 43.1: (a) IOM reports on the major changes needed for both practicing clinicians and educators and federal efforts to address the need for widespread HIT adoption. The Technology Informatics Guiding Education Reform (TIGER) has become a significant catalyst for change in addressing the IOM's call for healthcare transformation. The first report addressed major changes needed for both practicing clinicians and educators. The second report called for new ways for health professionals to be educated and it identified five core competencies for all healthcare professionals.

Question 43.2: (c) Convened a meeting of NI leaders and educators to discuss NI challenges. The first official TIGER gathering was held on January 14, 2005, hosted by Johns Hopkins University School of Nursing. A diverse group of nursing leaders from across the country engaged in conversation about the skills and knowledge needed by healthcare provider/nurse of the 21st century.

Question 43.3: (b) Interweave enabling technologies in nursing practice and education. Several (five in all) TIGER vision statements and expected outcomes were developed to guide the early stages of this initiative: (1) the vision above,

(2) allow informatics tools to be used by nurses, (3) publish summit report, (4) establish guidelines for organizations to follow, and (5) set an agenda for nursing organizations to bridge the quality chasm via information technology strategies.

Question 43.4:

- **a.** Had to identify a definable action plan goal True ___ X False ___
- **b.** Had to show commitment to the TIGER Vision and Action Plans True ___ X False ___
- **c.** Had to show a continued commitment to promote and engage others in the TIGER Initiative True ___ X False ___
- **d.** Had to sign the "TIGER Commitment Wall" True ___ X False ___
- **e.** Had to generate funds to keep TIGER alive True ___ False ___X

The invitational TIGER Summit was held at the end of October in 2006 and was hosted by the Uniformed Services University of Health Sciences (USUHS) in Bethesda, MD. Over 100 leaders from the nation's nursing administrative, practice, education, technology organizations, governmental agencies, and other key stakeholders participated in the very interactive 2-day summit.

Question 43.5: (b) A summary of the summit seven pillars as well as recommendations for specific stakeholders. The summit was focused on creating a movement on a 10-year vision and a 3-year action plan. The 10-year vision was more clearly evolved by doing collective work around seven pillars and then content streaming the patterns and most salient points.

Question 43.6: (a) Nine key collaborators were selected to address the summit recommendations by investigating further and preparing a final report on its purpose, outcomes, and access. A summary of the purpose, outcomes, and access to published reports is given in Table 43.1. It also provides Web sites to learn more about each committee's reports.

Question 43.7: (a) The creation of a Web site and Facebook account for connecting TIGERs together. The new TIGER Web site, www.thetigerinitiative.org, was established which has been the central hub for connecting TIGERs and sharing the many TIGER activities that occur with more than 1500 volunteers that have been engaged with the TIGER Initiative.

Question 43.8:

- **a.** It provides a dynamic and real-time information on topics such as electronic health records True ___ X False ___
- **b.** Opportunity for sponsors to discuss contributions of nurses True ___ X False ___
- **c.** Allows users to download information into a virtual briefcase True ___ X False ___
- **d.** Allows users to engage in social media and chat rooms on amazon.com True ___ False ___ X
- **e.** Enables interprofessional teams in practice and academia to leverage TIGER to learn True ___ X False ___

The VLE provides an interactive Web-based learning opportunity which included information about HIT and related topics for healthcare professionals and consumers.

Question 43.9: (a) Increase vision/mission across international borders and more actively engage in interprofessional colleagues in education and practice. The first step in international expansion was at NI2012 Conference in Montreal, Canada where the International Committee was officially launched with five countries: Brazil, United Kingdom, Taiwan, Germany, and Canada. A TIGER session was held at MEDINFO 2013 conference in Copenhagen.

Question 43.10: (c) It provides information, tools, and resources for leaders to access and utilize as they integrate technology into practice and education. The Revolutionary Leadership Report renamed *The Leadership Imperative: TIGER's Recommendations for Integrating Technology to Transform Practice and Education* is being published to fulfill the vision and mission to lead the way by providing transformational leadership that drives and executes the transformation of healthcare.

44

Initiation and Management of Accessible, Effective Online Learning

• OBJECTIVES

1. Explore the past and present perspectives of distance education.
2. Compare and contrast important interactive electronic tools that support online learning.
3. Examine essential strategies and types of support required for the online learner and faculty.
4. Recognize future trends in online education.

• KEY WORDS

Distance education
Faculty workload
Online learning
Faculty development

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What is online education? Can you give examples? Have you enrolled in an online course? What is an MOOC? Have you enrolled in an MOOC? What are some positive aspects of online education? What are some challenges of online education? Why is online education important to nursing?

For a WIIFM statement, say to the class, "This chapter focuses on today's high-quality, cost-effective, learner-centered approach to online education, examining it from both the student and faculty perspectives. This includes the importance of applicable educational principles needed to promote interactivity; legal, ethical, and copyright issues; active learning; and effective learner and student support, as well as some of the major academic and pedagogic issues impacting faculty developing creative courses." As a nurse, it is important to understand the importance of online education.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Definitions

1. **Overview**
   a. The literature still tends to use a variety of terms such as distance education, Web-based or online learning, and online education to reflect this type of nontraditional education, which in educational reality is becoming a mainstream approach to learning
      (1) Some definitions include "institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors"
      (2) The concept is now associated with learner accessibility, since online learning is experienced locally or globally, at home, a dormitory, or in the workplace, regardless of a rural or urban setting, across state lines, and even internationally
      (3) The American Association of Colleges of Nursing (AACN) continues to use Reinert and Fryback's and Russell's definitions to further clarify this type of

learning as "a set of teaching/learning strategies to meet the learning needs of students that are separate from the traditional classroom setting and the traditional role of faculty"

(4) Today with the use of the Internet, the terms *online education* and *online learning* (which will be used interchangeably in this chapter) are being used to reflect the broader view of these educational experiences

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Goals for this Chapter

1. Overview
   - **a.** Following a brief historic review of distance education, this chapter focuses on today's high-quality, cost-effective, learner-centered approach to online education, examining it from both the student and faculty perspectives
     - **(1)** This includes the importance of applicable educational principles needed to promote interactivity; legal, ethical, and copyright issues; active learning; and effective learner and student support, as well as some of the major academic and pedagogic issues impacting faculty developing creative courses

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Historical Evolution

1. **Overview**
   - **a.** This type of education has always experienced bumps and surges of acceptance
     - **(1)** Even the term *distance* education denotes remoteness or isolation to call attention to the differences from the traditional classroom education
     - **(2)** While distance education has been available in the United States since before the turn of the 19th century, schools and educators have often required a reason to develop and conduct education for students beyond the traditional classroom setting
     - **(3)** Initial development centered primarily on vocational training
   - **b.** Historically, educational regulatory agencies have not been very supportive; approval for off-campus or extension sites were needed when the sites were separated from the originating school or when geographical barriers existed, even when the same faculty were teaching both types of courses
     - **(1)** Some states even defined the number of miles for approval
     - **(2)** Another approach to distance education, depending on the school's technological resources, could also mean that the faculty drove "the distance" to the off-campus sites, then provided face-to-face (F2F) instruction
2. **Use of technology**
   - **a.** The advent of print, audio, television, and the computer have assisted distance education strategies, and eventually led to online learning
     - **(1)** In the United States, the distance education movement
       - **i.** Began with the Boston-based Society to Encourage Studies at Home in 1873
       - **ii.** Followed in 1885 by the University of Wisconsin developing "short courses" and Farmer's Institutes
     - **(2)** By 1920, a Pennsylvania commercial school for correspondence studies had enrollments of more than 2,000,000
     - **(3)** Unfortunately, dropout rates averaged around 65%
     - **(4)** In 1919 radio was the first technology used for distance education, later followed by telephone service
     - **(5)** Wisconsin again became a pioneer by using audio conferencing equipment with telephone handsets, speaker phones, and an audio bridge to connect multiple phone lines for the first two-way interactive distance education for physicians and nurses
     - **(6)** Next came television, so that complex and abstract concepts could be illustrated through motion and visual simulation
     - **(7)** Satellite technology for distance education in the United States was implemented in the early 1980s
   - **b.** As these methodologies grew in sophistication and complexity, distance education students began to experience greater transparency of the technology, which enhanced the educational experience
   - **c.** Computer technology came slowly to the forefront of distance education with computer-based education (CBE), computer-assisted instruct
     - **(1)** Yet, it has been the combination of the various interactive Web-based technologies that have really provided the force for creative educational strategies, as well as innovative ideas from faculty that have provided the momentum and impact of online education

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Examining Technologies Used in Online Learning

1. **Learning management systems**
   - **a.** A learning management system (LMS) is a software product that was first designed for corporate and government training divisions as a tool to assess workers' skills for job positions, and then provide specific training, either individually or in groups
     - **(1)** Learning management systems are also commonly used for K–12 education and the higher education level to track student achievement in outcomes-based educational programs
     - **(2)** Another term for LMS that is used more frequently in academic settings is Course Management System (e.g., Blackboard and Desire2Learn)

(3) They provide the same functionality as an LMS

(4) The general functions for LMS software includes
  i. Distribution of course content
  ii. Communication among the users
  iii. Interaction with course resources
  iv. Testing, grading, and tracking records

b. LMS becomes significantly more powerful by incorporating third-party applications such as Turnitin, Respondus, Lockdown Browser, and provides an array of sophisticated features

2. Content management systems

a. A content management system is a database of learning objects, which may include many items developed for instructional use

(1) A content management system allows course developers to develop learning objects such as videos, modules, assessments, or any other materials used for online learning

(2) It provides version tracking so that changes to these learning objects can be implemented without losing previous versions of the items

(3) Another benefit to such systems is the ability of developers to share learning objects

(4) They can be used as previously developed or modified to fit the need of the current course

(5) Finally, content management systems are designed to integrate with course management systems

(6) This allows the development of materials to take place outside the course itself

(7) Then, building the course becomes as simple as selecting learning objects and placing them into the course

(8) Course management systems such as *Blackboard* offer a content management system that is designed to fully integrate with their system

3. Emergence of massive open online courses

a. A massive open online course (MOOC) is a model for delivering free learning content

(1) Many MOOCs do not require prerequisites other than Internet access and interest

(2) Recently, MOOCs are beginning to offer academic credit

(3) The concept of MOOCs originated in 2008 among the open educational resources (OER) movement

(4) MOOCs provide participants with course materials that are normally used in a conventional education setting—such as examples, lectures, videos, study materials, and problem sets

(5) MOOCs are typically provided by higher education institutions, often in **partnership with "organizers"** such as Coursera, edX, and Udacity, though some MOOCs are being offered directly by a college or university

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Mobile Computing

1. Overview

a. The rapid changes in new technologies and access to content anywhere and anytime, allow learners to experience learning in a variety of settings and not just in schools

(1) Mobile computing devices are playing an increasingly important role in our personal, professional, and educational life

(2) There are many different mobile devices including personal digital assistants (PDAs), smartphones, tablet PCs, and laptop computers

(3) The recent advances in mobile devices make online learning possible through the powerful computing capability built into their conveniently small sizes, Internet connectivity, and the availability of many types of mobile software applications (apps)

(4) Because of the mobility and strong Internet connectivity, learning becomes ubiquitous and seamless

b. Learners who are taking online courses can use mobile devices anywhere to access the course content, complete learning activities, communicate with classmates, and work on group projects

c. Mobile devices become usable and functional enough to produce an impact on the education software industry, including LMS software

(1) The number of applications for mobile devices has increased dramatically

Teaching Tip
For example, Google Docs for mobile allows accessing, editing, and sharing documents.

(2) Books have also gone digital and for many people e-books are now more desirable than books

(3) Readers have the freedom to read e-books using e-raiders like Kindle or Nook, tablets, and smartphones

d. Although the integration of functional mobile computing devices is no longer the real challenge, the focus becomes mainly on how this technology should be used to fulfill the core mission of learning

(1) Swan, Hooft, and Kratcoski found that the effective use of the mobile device increases the quality and quantity of student work

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Faculty Support

1. Overview

a. With the number of online courses increasing, the American Association of State Colleges and Universities emphasizes the critical need for faculty well experienced in teaching online

(1) In order to assist in successful online education, faculty must receive appropriate support, technical expertise, and online infrastructure

    - **(2)** The role of the online instructor has developed into that of a facilitator rather than a knowledge distributor
    - **(3)** This is achieved by monitoring and guiding students to learn critical concepts, principles, and to develop skills, rather than just lecture material

2. Faculty development

- **a.** Faculty development is a critical component to the success of any online education, especially as colleges and universities are using numerous
    - **(1)** Adjunct faculty to assist with the increased student enrollments and teaching responsibilities
    - **(2)** Academic institutions are taking a proactive approach to faculty support
    - **(3)** Numerous workshops and one-to-one support in course development and technical issues are the most common types of training faculty receive
    - **(4)** The faculty development activities are designed to assist and improve faculty teaching at all levels of the educational programs. Workshops, seminars, Webinars, and peer coaching are among services available for faculty development
    - **(5)** The focus of these services should not be limited to technical skills development, but must include pedagogical issues

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

3. Disaggregated faculty

- **a.** According to Allen, Keough, and Armstrong a new disaggregated model for faculty content delivery has emerged and is designed for consistency of content delivery as programs respond to large numbers of students
    - **(1)** This model segregates design, teaching, and assessment of student learning into a team approach to course delivery
- **b.** Robison indicates the disaggregated model helps build a network of student support while the student is learning
    - **(1)** This model also provides access to a variety of perspectives due to the availability of different faculty in areas of knowledge providing learning enhancement

4. Support for course development

- **a.** Developing and delivering an effective online course requires pedagogical and technological expertise
    - **(1)** Instructors new to online teaching are not likely to have such skills

Teaching Tip

An example used at our university is the Jumpstart Program. Hixon defined Jumpstart as a series of workshops that may take more than a week. These workshops include a team of support professionals, including instructional designers, librarians, and media production specialists, who help faculty increase their knowledge, productivity, and teaching experience with technology. Evaluation findings document that this Jumpstart program significantly influences the faculty members in their online course development process.

- **b.** Allen et al. note that online course development requires a team involving instructional designers, technical support staff, and content experts
    - **(1)** The content expert offers an outline of topics that should be covered
    - **(2)** The instructional designer provides help in course structure organization and functionality, and the technical support provides assistance with integration of technology tools
    - **(3)** This model of team course development is common in most nonacademic settings and has been adopted by a number of academic organizations
    - **(4)** However, course development carried out by the instructors who will be teaching the course is still a common practice in many colleges and universities that offer online learning
- **c.** Technological tools for online learning are constantly being developed and improved, with the aim to make online learning more interesting and more effective
    - **(1)** Regardless of faculty teaching experience, technology support is critical in online teaching
    - **(2)** Appropriate training on using new technologies, routine technical support, and instructional guidance are the common supports that faculty receive

5. Faculty workload

- **a.** Faculty workload refers to the number of courses taught by an instructor
    - **(1)** The allocation of faculty time in Higher Education usually includes teaching, scholarship activities, and community service
    - **(2)** Because teaching online is thought to require more time and effort compared with traditional F2F teaching, workload adjustment is usually used by institutions to promote faculty involvement in nonteaching activities
- **b.** Actual research into the assumption of increased development time has been limited
    - **(1)** Freeman's research findings suggest that the time spent with online course development seems to be proportional to classroom teaching
    - **(2)** As with traditional classroom development, usually the extra time devoted to making the course effective and applicable then produces a significant reduction of faculty time after first-time delivery
    - **(3)** Freeman offers four Lessons for Distance Education Administration
        - **i.** Make sure faculty understand that they are starting something new
        - **ii.** Teach your faculty to think about their course in a different way, to be ready to do things differently
        - **iii.** Use your instructional designers. As the faculty member is developing the course with the instructional designer, the designer should be on the lookout for time-consuming approaches
        - **iv.** The more an administrator knows about the process of course development, the better he/she can manage [the faculty workload issue]

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Course Development

1. Overview
   - **a.** The use of the Web for courses can be divided into three categories: hybrid courses, Web-enhanced F2F courses, and fully online courses

Teaching Tip
The selection of approach depends on the needs of the organization, the nature of the content, and the faculty as summarized in Table 44.2.

2. **Learner assessment in online courses**
   - **a.** Assessment is an important aspect in the learning process
     - **(1)** *Assessment* is defined as a means to test and evaluate student performance and ensure that students meet the outcomes designed for the course
     - **(2)** The assessment may take different forms, such as
       - **i.** Online quizzes and exams
       - **ii.** Self-assessment: Students assess their own learning as they progress through the course
       - **iii.** Online discussion: Students respond to questions, reply to peers messages, and discuss course materials
       - **iv.** Papers: Students submit research papers, or essays. Posting papers to the online discussion forum can spark discussion. Rubrics provide guidelines and a method for self-evaluation
       - **v.** Individual or collaborative projects: Students develop a project individually or as members of a group by using clear directions and guidelines
       - **vi.** Presentations: Synchronous communication systems can be used to make presentations or even have debates. A student can use a whiteboard or show a Web site they would like everyone to view while holding a live discussion
       - **vii.** ePortfolio: It is an online application for collecting the student's work that demonstrates meaningful documentation of individual abilities. Electronic portfolios can serve as a mean to assess student's ability over time, and if the student has met each objective or learning outcome as determined by the instructor or the academic program

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Student Support

1. **Overview**
   - **a.** One of the most critical factors in a student's success with online learning is student support
     - **(1)** Moore and Kearsley noted that the absence of student support could drastically affect student retention, and tends to increase student frustration and feelings of inadequacy, which in turn leads to the student dropping out of the program
     - **(2)** Several investigators have proposed a wide range of student support services that should help students be successful
     - **(3)** These services include
       - **i.** Precourse orientation
       - **ii.** Free tutoring services
       - **iii.** Online technical support
     - **(4)** These academic services allow students to be familiar with the technology and improve student-to-instructor and student-to-student communication
     - **(5)** The main goal is to increase students' ease with the cyber environment and encourage constant connection with their peers
     - **(6)** In addition to academic support, services that focus on students' affairs are also important to success and retention
     - **(7)** Services such as online library resources, online advising, and a common course management system could be part of an integrated student support system aimed at making online learning exciting and successful
2. **Orientation to the online environment**
   - **a.** Orientation programs designed to introduce new students to the online environment are crucial to assure a smooth transition, especially for students without prior experience in online learning
     - **(1)** The goals of orientations and tutorials are to ensure that students are familiar with the online environment and are aware of expectations
     - **(2)** Free tutorials are also helpful, especially with difficult or challenging tasks such as
       - **i.** Navigating the Web course space
       - **ii.** Using new software packages and/or equipment
       - **iii.** Or performing technical procedures (e.g., uploading a file to a Web site)
3. **Communication and flexibility**
   - **a.** There are two basic types of Web-based communication
     - **(1)** Asynchronous communication tools such as e-mail, discussion boards, and blogs. Course participants use these tools when they are online; however, the person to whom they communicate may not be online. They serve as a messaging interface between communicators
     - **(2)** Synchronous communication tools require participants to be online to communicate at the same time. These tools include chat, whiteboard, desktop conferencing, and video conferencing such as Skype
   - **b.** To ensure effective communication, instructors must select the most appropriate tool for the class
     - **(1)** This will depend on accessibility to the technology and the levels of students' skills
     - **(2)** Communication is strongly affected by course flexibility (due dates and/or assignment submission)

    - **(3)** Building flexibility in the course structure allows the faculty to compensate for unexpected technological problems, as well as provides opportunities to respond to student feedback

4. **Accessibility in online learning**
   - **a.** To avoid creating barriers in online learning, federal and state laws, and local guidelines and policies for online learning such as Americans with Disabilities Act (ADA) and Rehabilitation Act, require that the online learning should be accessible to the broadest range of possible learners
     - **(1)** Accessibility of content becomes a legal requirement in many situations
     - **(2)** It is important to present instructional content in a format that accommodates the diverse needs and learning styles
     - **(3)** Some elements for accessibility include
       - **i.** Alternative text for images
       - **ii.** Appropriate color and contrast
       - **iii.** Accessible and consistent navigation
       - **iv.** Closed captioning for audio/video materials
   - **b.** Accessibility also applies to online testing. Students with disabilities can have many different types of limitations that affect their abilities to take tests
     - **(1)** These individuals who are protected by disability legislation can ask for alternative format and extra time to take tests
     - **(2)** Students must apply for an "accommodation" through the university's student services for accommodations to be made by the school

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Legal, Ethical, and Copyright Issues

1. **Overview**
   - **a.** The faculty is accountable for educational content they teach
     - **(1)** However, accountability is even more at the forefront of education at this time
     - **(2)** Eaton defines accountability as the "how and the extent to which higher education and accreditation accept responsibility for the quality and results of their work and are openly responsive to constituents and the public"
   - **b.** The Higher Education Act, reauthorized in 2008, made additional demands on accreditors to be more accountable and subsequent creation of rules during 2009 and 2010 expanding accountability expectations even more
   - **c.** Legal concerns relate to established laws associated with telecommunication technologies
   - **d.** Ethical concerns relate to the rights and wrongs stemming from the values and beliefs of the various users of the distance education system
     - **(1)** Three major areas that are of concern regarding legal issues include
       - **i.** Copyright protection
       - **ii.** Interstate commerce
       - **iii.** Intellectual property
     - **(2)** Privacy, confidentiality, censorship, freedom of speech, and concern for control of personal information continues to be as relevant today as in 1998 when Bachman and Panzarine identified these cyber ethical issues
2. **Copyright protection**
   - **a.** Copyright is a category of intellectual property and refers to creations of the mind
     - **(1)** According to the World Intellectual Property Organization (WIPO), the Standing Committee on Copyright and Related Rights (SCCR) is currently engaged in discussion of:
       - Limitations and Exceptions
       - Broadcasting Organizations
     - **(2)** This protection for copyright is based on the Copyright Act of 1976, and was last amended in November 1995
   - **b.** Copyright law protects "works of authorship," giving developers and publishers the right to control unauthorized exploitation of their work
     - **(1)** Although there have been no new federal laws since 1976 to address educational multimedia concerns, the Consortium of College and University Media Centers has published the Fair Use Guidelines for Educational Multimedia
     - **(2)** When combining content such as text, music, graphics, illustrations, photographs, and software it is important to avoid copyright infringement
     - **(3)** Additionally, the Digital Millennium Copyright Act was passed in October 1998
     - **(4)** The UCLA Online Institute for Cyberspace Law and Policy list the highlights of the Digital Millennium Copyright Act and the United States Copyright Office Summary can be located on the Internet
     - **(5)** As noted by the dates of citations here, regulations and legislative guidance seem to lag from the technological changes incorporated within the online educational arena
3. **Intellectual property**
   - **a.** A common question by faculty is, "Who owns the course?"
     - **(1)** According to Kranch there is a great deal of controversy over who owns academic coursework materials
     - **(2)** United States copyright law is intended to provide ownership and control of what an individual has produced
     - **(3)** However, its relationship to faculty-produced work is not as clear
     - **(4)** Although faculty may own the materials they have developed for use in their online courses, it is always good to have a memo of understanding documenting the specific use of the materials as well as the accrued benefits

- **b.** The issue of "work made for hire" is the point of controversy
  - **(1)** According to the 2003 US Copyright Office document, as indicated by Kranch, a "work made for hire" is defined in the following ways
    - **i.** A work prepared by an employee within the scope of his or her employment
    - **ii.** A work specially ordered or commissioned for use as a contribution to a collective work
- **c.** The bottom line of this section is that faculty should know their employer's policy pertaining to intellectual property rights
  - **(1)** Over the last several years, universities, government, and private organizations have noted the need to clearly delineate their policies in this area

Teaching Tip
For example, our school has an established university-wide committee providing advisory opinions to the Provost on matters related to patentable discoveries and inventions, and/or copyrightable material, which had been developed by university employees.

- **d.** Open Courseware is a free and open digital publication of educational material
  - **(1)** However, there are specific guidelines and requirements for the use of Open Courseware
  - **(2)** Although Open Courseware is available to anyone, material used in education from any Open Courseware participant is consistent with materials from any university and/or faculty
  - **(3)** Additional information on Open Courseware can be found on the Internet
- **e.** Extensive resources on intellectual property law and rights can be found at the following sites:
  - **(1)** Indiana University Information Policy Office
  - **(2)** Office of Technology Transfer and Intellectual Property at Texas Tech University Copyright
  - **(3)** Intellectual Property
  - **(4)** Legislative initiatives regulating intellectual property and copyright are found in the Technology, Education and Copyright (TEACH) Act
  - **(5)** The Berkeley Digital Library at Sunsite is an excellent resource for national perspectives on intellectual property
  - **(6)** The Creative Commons Web site is a nonprofit organization that works to increase the amount of creativity in the body of work available to the public for free and legal sharing, use, repurposing, and remixing
- **f.** Ethical behavior in the nursing profession has been established by groups such as the American Nurses Association (ANA) in the Code of Ethics and the AACN's competencies for baccalaureate nursing education
  - **(1)** These nursing values and ethics are fundamental in practice decisions and are just as applicable in nursing education, whether education be F2F or online
  - **(2)** Mpofu regards ethical considerations in online teaching as performing your work within the context of professional practice and the confines of institutional regulations
  - **(3)** However, over and above professional and institutional ethics, nurse educators must contend with legal and ethical issues that take on a new dimension when applied to online education
  - **(4)** While issues such as copyright, privacy, licensing, fair and acceptable use, and plagiarism are certainly not unique to online education, they assume new dimensions and different proportions
  - **(5)** Another source for consideration with ethics issues can be found in *Best Practice Strategies to Promote Academic Integrity in Online Education*

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Effectiveness of Online Education

1. **Overview**
   - **a.** Online learning for nursing courses is exploding. Advertisements about "new online education for working professionals" certainly have appeal, capturing the attention of many people seeking to fit further education into their busy schedules
     - **(1)** There are still some traditional students who do not pay attention to online education
     - **(2)** There are still some faculty who avoid the concept by raising questions of quality rather than exploring the educational principles used in online learning
     - **(3)** There are still some who believe the only "gold standard" of education continues to be the traditional classroom setting
     - **(4)** Additionally, questions emerge concerning the validity of the courses:
       - **i.** Is it really possible to earn a degree while at home or in the work setting without driving long distances and sitting in tedious lecture classes?
       - **ii.** Is the interaction with the faculty equal to the same interaction that occurs in the classroom?
       - **iii.** Is this really applicable to clinical nursing?
     - **(5)** Overall, market-driven demands of educational reform and creative, visionary faculty have moved online learning, transforming both academic and continuing nursing education, by capturing new types of educational experiences and innovative kinds of pedagogy
     - **(6)** The outcomes have been an empowerment of the nursing student and working professional to have numerous important educational choices
     - **(7)** Now, in addition to quality, the educational decisions are often based on accessibility and the amount of time needed to complete the course or program
   - **b.** Online learning offers more alternatives to accommodate individual circumstances and educational needs
     - **(1)** Now, it is becoming a commonly accepted instructional method in higher education institutions, and the

numbers of online courses are constantly increasing to accommodate the large number of students enrolling

(2) For the past 6 years, online enrollment has grown at a greater rate than the total higher education enrollment

(3) According to the Sloan Consortium Report, overall online enrollment increased to 7.1 million in 2013, with the majority of doctoral-granting universities (80%) offering online courses or programs

c. In order to purport quality, educational outcomes must be similar for both the on-campus and online learning students; countless studies over at least three decades have documented this

(1) Findings reflect that regardless of the delivery method, online learning students receive the same grades or do better than those students receiving traditional instruction

(2) Overall, student evaluations are good to very good following online education activities. In essence, good online education theory and good education theory are actually the same; the education just transcends the barriers of time and space

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Program Evaluation and Accreditation

1. Overview

a. Program evaluation is an ongoing process in online education and requires a framework for evaluation to be adopted by the faculty, standards and outcomes to be defined, as well as a timeline for measurement of outcomes

(1) Program evaluation focuses on review and improvement

(2) The need for curriculum revision, resources, and faculty and staff may become apparent during this ongoing review process

(3) Program evaluation allows educators to facilitate meaningful change, while providing feedback

(4) All program evaluation gathers evidence for measurement against predetermined outcomes

(5) The framework will provide the steps to outcome attainment

(6) With systematic program evaluation, revision decisions are based on the evidence from findings rather than assumptions

(7) To obtain this evaluative data, program surveys by faculty, students, and administrators should be completed and analyzed annually

(8) Additionally, course surveys should be completed by students at the end of each course

b. Regional accreditation agencies assist in guiding programs for maintaining standards in program delivery, and regional credentials are sought after by major colleges and universities

(1) Regional accreditation is a continuous improvement process involving the entire university or college

(2) Many of the regional accrediting agencies, such as the Southern Association of Colleges and Schools (SACS), engage the college or university to pursue a continuous improvement process of self-evaluation, reflection, and improvement for not only F2F learning but distance learning as well

(3) Other regional accrediting agencies providing excellent resources for online program assessment and evaluation include

i. Western Interstate Commission on Higher Education (WICHE)

ii. WICHE Cooperative for Educational Technologies (WCET), a division of WICHE, providing good practices and policies to ensure the effective adoption and appropriate use of technologies in teaching and learning online

c. Accreditation agencies require that each facet of the online program be critically and logically appraised to reflect the quality of the programmatic goals and outcomes designated within the program

(1) There is no one type of accreditation applied to online education

(2) In fact, there are several types of accreditations for different institutional statuses, and they are categorized into regional, national, and professional accreditations

Teaching Tip
See Table 44.3.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Standards for Quality in Online Education

1. Overview

a. To ensure the quality of online education, various organizations (Table 44.4) have recently developed standards for this type of education

(1) The main purpose of these standards is to guide the development and evaluation of online learning programs offered through colleges and universities

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Future Trends

1. Overview

a. The future trends in online learning will be defined by student empowerment and technological advancements

(1) The population and student enrollments have grown extensively during the last 6 years and it is anticipated that the field of online education will witness a tremendous growth both in terms of quantity as well as quality

Teaching Tip

For example, Hodgins predicts that learning content will be customized for each learner, rather than mass-produced.

- **(2)** In the future, data analytics will be used to identify individual student learning needs and the role of faculty as mentors will be strengthened
- **(3)** Huge data sets will allow advisors to see academic risks in real time and intervene with the student
- **(4)** By focusing on processes of actual cognitive development Stanford University is researching new forms of assessment in order to measure 21st-century skills
- **(5)** Additionally, immersive virtual learning environments tailored to the learner's desired competency set will emerge
- **(6)** Here the student will enter an immersive virtual environment which transcends real world time and there be paired with virtual teammates designed to enable the student to meet identified competencies

b. The next apparent trend changing online learning is the advancement of technologies

- **(1)** Gaming, learning analytics, and mobile applications are now the norm as well as tablet computing and use of e-books
- **(2)** We now expect tools to have geo-everything and gesture-based computing through a tap or a swipe, but the future may bring technology that allows computing through subtle body gestures with wearable computing
- **(3)** Along with the wearable technology, 3D printing will become commonplace
- **(4)** Futurists have been predicting the rise of the *ubiquitous computing device* for years
- **(5)** A ubiquitous device is one to which users have become so accustomed, they no longer notice the device itself when they are using it
- **(6)** Instead, users tend to focus on what they get from the device

Teaching Tip

One example of this in our life is the refrigerator. We may open the door of the refrigerator, but often are thinking of the food we get from the device, rather than the device itself.

- **(7)** Some authors go even further, defining the ubiquitous device as a single device or service that takes care of all of our computing needs
- **(8)** These computing devices will continue to be part of an exciting new world for online learning opportunities

c. The 2013 Horizon Report by the New Media Consortium described six technologies that universities will likely mainstream within the next 5 years

- **(1)** One of these technologies is gesture-based computing, which is also called Gesture Recognition
- **(2)** This refers to technology that recognizes and interprets the motions and movements of its users
- **(3)** Instead of using the mouse or keyboard, the users employ natural body movements to control the device, such as shaking, rotating, tilting, touching, or moving the device in space
- **(4)** It is expected that in 4–5 years, this type of technology will emerge in educational settings and have a considerable impact on teaching and learning

d. There will be more technologies that offer live interactive instruction

- **(1)** With all the growth in online education, the need for effective course management systems will be ever more crucial
- **(2)** Furthermore, technological advancements will also increase the need for developing effective teaching strategies that exploit the capabilities of technology
- **(3)** MOOCs will continue to explode as noted in the latest NMC Horizon Report
- **(4)** The movement on the horizon is for MOOCs to determine mechanisms for awarding credit

e. Skiba recently noted students of the future will use mobile devices more

- **(1)** But will also still value a mix of online and F2F learning environments and although technology will enhance achievement of their learning goals students will continue to value privacy
- **(2)** There is a limit to connectivity and students will continue to keep academic and social lives in separate silos

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Explore the past and present perspectives of distance education
- Compare and contrast important interactive electronic tools that support online learning
- Examine essential strategies and types of support required for the online learner and faculty
- Recognize future trends in online education

Teaching Tip

Ask the students to define the keywords

- Distance education
- Faculty workload
- Online learning
- Faculty development

CHAPTER REVIEW QUESTIONS

Question 44.1: What are other names of the technological uses of online learning and online education?

a. Distance education, interactive education, and nursing process
b. CBE, CAE, CME, and distance education
c. CAE, nursing process, and interactive education
d. Nursing process, CBE, and distance education

Question 44.2: Which one is considered the best technology to deliver online education?

a. Software tool to assess workers skills
b. Content management system
c. MOOC
d. Mobile computing devices via Internet (Web-based technologies)
e. Faculty educational programs

Question 44.3: What are some software products and tools designed for learning management systems (LMS)?

a. Asynchronous communication, collaborative products development, testing and grading, social media integration, access database software
b. Synchronous communication, collaborative products development, testing and grading, access database software, and social media integration
c. Synchronous communication, asynchronous communication, testing and grading, social media integration, and access database software
d. Synchronous communication, asynchronous communication, collaborative products development, testing and grading, and social media integration

Question 44.4: What are some of the advantages of content management systems?

a. Version tracking of learning objects, share learning objects, integrate with course management systems, and prepare testing and grading of learning objects
b. Develop learning objectives, version tracking of learning objects, share learning objects, and integrate with course management systems
c. Develop learning objectives, share learning objects, prepare testing and grading of learning objects, and integrate with course management systems
d. Develop learning objectives, version tracking of learning objects, share learning objects, and prepare testing and grading of learning objects

Question 44.5: What is massive open online course (MOOC) developed in 2008?

a. Online open course model for delivering free learning content
b. Educational model for classroom teaching
c. Educational model for supporting face-to-face teaching university courses
d. New model for teaching only NI

Question 44.6: What are the advantages of online mobile computing courses?

a. Access online courses anywhere, complete learning activities, communicate with classmates, and work on group projects
b. Complete learning activities, communicate with classmates, work on group projects, and decrease the quality and quantity of work
c. Access online courses anywhere, decrease the quality and quantity of work, communicate with classmates, and work on group projects
d. Decrease the quality and quantity of work, access online courses anywhere, complete learning activities, and communicate with classmates

Question 44.7: Which best represents the role of faculty in online education?

a. Faculty is the facilitator rather than a knowledge distributor True ___X False ___
b. Monitoring and guiding students to develop skills True ___ X False ___
c. Faculty development is not necessary in online education True ___ False ___ X
d. Faculty training for online education is based on experience True ___ False ___ X
e. Faculty development is designed to assist and improve faculty teaching True ___X False ___

Question 44.8: Which of the following support online education course design?

a. It requires a team involving content experts, instructional designers, and technical support staff
b. It requires only the use of technological tools which are being developed and improved
c. It needs the faculty to attend workshops that help professionals increase faculty knowledge
d. Faculty must obtain appropriate training on using new technologies
e. Faculty must obtain student input in the course development

Question 44.9: What are the major assessment tools used to test and evaluate student outcomes in their performance in the online learning process?

a. Papers and presentations, self-assessments, collaborative projects, online discussions, and free tutoring services
b. Online quizzes and exams, self-assessments, collaborative projects, free tutoring, and online discussions
c. Online quizzes and exams, free tutoring services, papers and presentations, self-assessments, and collaborative projects
d. Online quizzes and exams, papers and presentations, self-assessments, collaborative projects, and online discussions

Question 44.10: Which of the following represent a legal, ethical, and copyright issue?

- **a.** Legal concerns related to NI
- **b.** Ethical concerns related to safety
- **c.** Copyright concerns related to the legal authorship of the intellectual property
- **d.** Concerns on free Open Courseware

ANSWERS AND EXPLANATIONS

Question 44.1: (b) CBE, CAE, CME, and distance learning. Computer technology came slowly to the forefront of distance education with computer-based education (CBE), computer-assisted education (CAI), and computer managed instruction (CMI) and then their use exploded.

Question 44.2: (d) Mobile computing devices via Internet (Web-based technologies). Mobile computing devices are playing an increasingly important role in making online learning possible through the powerful computing capability built into their conveniently small sized, Internet connectivity and the availability of many types of mobile software applications.

Question 44.3: (d) Synchronous communication, asynchronous communication, collaborative products development, testing and grading, and social media integration. A learning management system (LMS) is a software product that was first designed for corporate and government training divisions as a tool to assess workers' skills for job positions, and then provide specific training, either individually or in groups. LMS features include the five listed above.

Question 44.4: (b) Develop learning objectives, version tracking of learning objects, share learning objects, and integrate with course management systems. A content management system is a database of learning objects, which may include any items developed for instructional use. It allows course developers to develop learning objects such as videos, modules, assessments, and any other materials used for online learning.

Question 44.5: (a) Online open course model for delivering free learning content. MOOCs provide participants with course materials that are normally used in a conventional education. MOOCs are typically provided by higher education institutions, often in partnership with "organizers" such as Coursera.

Question 44.6: (a) Access online courses content anywhere, complete learning activities, communicate with classmates, and work on group projects. Because of the mobility and strong Internet connectivity, learning becomes ubiquitous and seamless.

Question 44.7:

a. Faculty is the facilitator rather than a knowledge distributor True ___ X False ___

b. Monitoring and guiding students to develop skills True ___ X False ___

c. Faculty development is not necessary in online education True True ___ False ___ X

d. Faculty training for online education is based on experience True ___ False ___ X

e. Faculty development is designed to assist and improve faculty teaching True ___ X False ___

This is achieved by monitoring and guiding students to learn critical concepts, principles, and to develop skills, rather than just lecture material.

Question 44.8: (a) It requires a team involving content experts, instructional designers, and technical support staff. The content expert offers an outline of topics that should be covered; the instructional designer provides help in course structure, organization, and functionality; and the technical support provides assistance with integration of technology tools.

Question 44.9: (d) Online quizzes and exams, papers and presentations, self-assessments, collaborative projects, and online discussions. Assessment is an important aspect in the learning process. Assessment may take different forms. The selection of approach depends on the needs of the organization, the nature of the content, and the faculty requirements.

Question 44.10: (c) Copyright concerns related to the legal authorship of the intellectual property. Ethical behavior in the nursing profession has been established by groups such as the ANA in the Code of Ethics and the AACN competencies for baccalaureate nursing education. The nursing values and ethics are fundamental in practice decisions and are just as applicable in nursing education whether education be face-to-face or online.

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Social Media in the Connected Age: Impact on Healthcare Education and Practice

• OBJECTIVES

1. Describe the evolution of the Internet and the movement toward the Connected Age.
2. Describe the use of social media and mobile tools in healthcare education and practice.
3. Identify the challenges and issues related to the use of social media in healthcare education and practice.

• KEY WORDS

Connected Age
Digital tools
Social networking
Social media
Mobile apps

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Can you give examples of social media? Why would social media be important in healthcare? What are some challenges in using social media in healthcare? What are some benefits of using social media in education? What are some challenges in using social media in education?

For a WIIFM statement, say to the class, "In this chapter, there is a brief history of the evolution of the Internet to the Web and now to the Connected Age. There is a specific focus on the use of social media digital tools, and its impact on healthcare and education. This is particularly true as we evolve from the Web 2.0 era to the Connected Age where it is not only access and interactions but about establishing relationships. As Sarasohn-Kahn noted, 'the use of social media on the Internet are empowering, engaging and educating consumers and providers in healthcare.' In the Connected Age, everything and everyone is interconnected that ultimately will have an impact on how we learn as well as how we receive healthcare. The benefits and challenges related to the growing use of these tools are also discussed." As a nurse, it is important to understand the role and importance of social media and mHealth in healthcare as well as education.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
   a. The Internet has revolutionized the computer and communications world like nothing before
      (1) The Internet is at once a worldwide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location
   b. There is no doubt the Internet provided the necessary infrastructure to revolutionize the way scientists and researchers from the worlds of academia, business, and government could share data, interact, and collaborate with each other

   (1) But it was not until the introduction of the World Wide Web that "everyday people" without computer programming skills were enabled to reap the benefits of this revolution

   (2) The Web not only changed how governments and businesses operate, it has impacted every facet of society—how we work, learn, play, and now, even how we manage our health

c. In this chapter, there is a brief history of the evolution of the Internet to the Web and now to the Connected Age

   (1) There is a specific focus on the use of social media digital tools, and its impact on healthcare and education

   (2) This is particularly true as we evolve from the Web 2.0 era to the Connected Age where it is not only access and interactions but about establishing relationships

   (3) Sarasohn-Kahn noted, "the use of social media on the Internet are empowering, engaging and educating consumers and providers in healthcare"

   (4) In the Connected Age, everything and everyone is interconnected that ultimately will have an impact on how we learn as well as how we receive healthcare

   (5) The benefits and challenges related to the growing use of these tools are also discussed

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Historical Perspective

1. Internet

a. As early as the 1960s, computer scientists began to write about the creation of a network of interconnected computers where scientists could share and analyze data by interacting across the network

   (1) According to Cerf, "the name 'Internet' refers to the global seamless interconnection of networks made possible by the protocols devised in the 1970s through DARPA-sponsored research"

   (2) The Internet is defined as "a computer network consisting of a worldwide network of computer networks that use the TCP/IP network protocols to facilitate data transmission and exchange"

   (3) Over the next decade, various government agencies and companies conducted considerable research to support the advancement of the Internet

   (4) It was not until 1985 that a broader community, in particular the academic community beyond the computer scientists, was given access to the Internet

   (5) NSF funding for the Internet continued for almost a decade before the Internet was redistributed to regional networks with the eventual move toward interconnecting networks across the globe

b. As the Internet came to expand, Tim Berners-Lee wrote his seminal paper *Information Management: A Proposal* that circulated throughout the European Council for Nuclear Research (CERN) organization

   (1) The paper explicated his ideas that using a hypertext system that would allow for storage and retrieval of information in a "web of notes with links (like references) between them is far more useful than a fixed hierarchical system"

   (2) In 1990, Berners-Lee's paper was recirculated and he began development of a global hypertext system that would eventually become the World Wide Web (WWW)

   (3) As the WWW concept evolved, Marc Andreessen and Eric Bina at the University of Illinois developed a browser called Mosaic that provided a graphical interface for users

   (4) This browser is credited with popularizing the Web

2. World Wide Web

a. Overview

   (1) It is important to note that although many use the terms *Internet* and *Web* synonymously, there are differences between them

   (2) Whereas the Internet is the network of interconnected computers across globe, the Web is an application that supports a system of interlinked, hypertexted documents. One uses the Internet to connect to the Web

   (3) A Web browser allows the user to view Web pages that contain text, images, and other multimedia

b. Web 1.0

   (1) The Web in its first iteration (Web 1.0) allowed users to access information and knowledge housed on Web pages complete with text, images, and even some multimedia

   (2) It was considered a dissemination vehicle that democratized access to information and knowledge

   (3) Many in the field designate the time period between 1991 and 2004 as Web 1.0

   (4) This was an important era and, as noted by Friedman, the world suddenly became flat—his metaphor for the leveling of the global playing field

   (5) The convergence of the personal computer with the world of the Internet and all its services facilitated the flattening

   (6) The flattening was particularly powerful in the world of commerce but also exploded in higher education, making it easier for students to access knowledge beyond their own academic campus

   (7) For healthcare, it was a time where consumers could now have access to health information and knowledge that was not locked in an academic library or in a distant place

c. Web 2.0

   (1) O'Reilly and Dougherty introduced the term *Web 2.0* at a 2004 conference brainstorming session about the failures of the dot-com industry

   (2) It was apparent that despite the demise of the dot-com industry, "the Web was more important than ever, with exciting new applications and sites popping up with surprising regularity"

  - **(3)** There were several key concepts that formed the definition of Web 2.0
  - **(4)** First, the Web is viewed as a platform rather than an application
  - **(5)** Second, the power of the Web is achieved by harnessing the collective intelligence of the users
  - **(6)** A third important principle was that the Web provided rich user experiences
  - **(7)** The introduction of Web 2.0 embodies the long history of community spirit of the Internet conceived by its originators
  - **(8)** As Leiner and colleagues noted, "the Internet is as much a collection of communities as a collection of technologies, and its success is largely attributable to satisfying basic community needs as well as utilizing the community effectively to push the infrastructure forward"
  - **(9)** The transition from an information dissemination platform to an engaging, customizable, social, and media-rich environment epitomizes this next generation of the Web
  - **(10)** As Downes stated, "the Web was shifting from being a medium, in which information was transmitted and consumed, into being a platform, in which content was created, shared, remixed, repurposed, and passed along"
  - **(11)** Another important feature was the idea of users interacting and sharing information, ideas, and content
  - **(12)** Owen, Grant, Sayers, and Facer aptly described the transition of the Web, "we have witnessed a renaissance of this idea in the emergence of tools, resources and practices that are seen by many as returning the web to its early potential to facilitate collaboration and social interaction"
  - **(13)** Although some have predicted that there will be Web 3.0, known as the Semantic Web, this never materialized as projected
  - **(14)** There have been more recent references to such terms as the Internet of Things (IOT) and the Connected Age
  - **(15)** Both are fairly similar but there are some distinctions
  - **(16)** Ashton first described the IOT as "a system where the Internet is connected to the physical world via ubiquitous sensors"
  - **(17)** In the 2012 Horizon Report (Johnson, Adams, & Cummins), IOT "is the latest evolution of network-aware smart objects that connect the physical world with information"
  - **(18)** Skiba noted, "Several attributes are associated with these smart objects; they are small, easy to attach and unobtrusive, contain a unique identifier and data or information, and can connect with an external device on demand (e.g., your smartphone or tablet)"

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Connected Age

1. Overview

- **a.** More recently, Oblinger introduced the concept of the Connected Age in higher education
  - **(1)** Abel, Brown, and Suess describe the Connected Age, as an environment that "offers new ways to connect things that were previously considered disparate and 'un-connectable': people, resources, experiences, diverse content, and communities, as well as experts and novices, formal and informal modes, mentors and advisors"
  - **(2)** Oblinger further noted "Connecting is about reaching out and bringing in, about building synergies to create a whole that is greater than the sum of its parts
  - **(3)** Connecting is a powerful metaphor
  - **(4)** Everyone and everything—people, resources, data, ideas—are interconnected: linked and tagged, tweeted and texted, followed and friended. Anyone can participate"
  - **(5)** As noted by Skiba, "In higher education, we can think of these as learning pathways, created by the individual or guided by other students or faculty
  - **(6)** The bottom line is that learning pathways are about connecting the dots—in the classroom, online, or even with people and places outside the traditional academic environment"
- **b.** In healthcare, Caulfield and Donnelly offered a model of Connected Health that "encompasses terms such as wireless, digital, electronic, mobile, and telehealth and refers to a conceptual model for health management where devices, services or interventions are designed around the patient's needs, and health related data is shared, in such a way that the patient can receive care in the most proactive and efficient manner possible
  - **(1)** In this model, patients, caretakers, and providers are 'connected' by means of timely sharing and presentation of accurate and pertinent information regarding patient status through smarter use of data, devices, communication platforms and people"
  - **(2)** Iglehart concurred that Connected health is "an umbrella term to lessen the confusion over definitions of telemedicine, telehealth and mHealth"
  - **(3)** Iglehart considered connected health as an emerging disruptive technology that has the potential to transform the healthcare delivery system
- **c.** IOT and Connected Age, speak to connections to everything and everyone
  - **(1)** IOT focuses on those connections with physical objects
  - **(2)** The Connected Age refers to more virtual connections especially with people, resources, and ideas
  - **(3)** It is within the context of the Connected Age that we examine the digital tools being used to transform education and healthcare practice
- **d.** In the Connected Age, digital tools are primarily associated within the broad context of social media and mobile applications
  - **(1)** The Pew Research Internet Project has witnessed three technology revolutions since it began studying the Internet

(2) The three revolutions include: broadband, mobile connectivity, and the rise in social media and social networking in everyday life

(3) The three revolutions are primary driving forces behind the Connected Age

(4) According to Fox and Rainie, the WWW turned 25 on March 14, 2014 and has reached 87% penetration in terms of adult usage in the United States

(5) There is also considerable growth of cell phones from 53% in 2000 to now 90% and also smartphones has increased to 58%

(6) When participants were asked about the impact on their lives, 90% claimed the Internet was a positive influence

(7) Users noted that being online was essential for not only job-related responsibilities but for many other facets of their lives such as learning, health, politics, family, friends, and community interactions

(8) It is interesting to note that 67% of users indicated that online communications were positive and strengthened relationships with family and friends

2. Facebook

a. In a 2013 update specific to social media, Duggan and Smith found that although 73% use social networking sites, Facebook being the most prevalent, there are 42% who are also exploring other social networking platforms

(1) On a daily basis, most users check both their Facebook and their instagram accounts

(2) There is a growing use of Pinterest, LinkedIn, and Twitter

b. In terms of mobile devices, the Pew Internet Research Mobile Fact Sheet indicated as of January 2014, 90% of American adults have cell phones of which 78% have smartphones

(1) There are also 52% of American adults with tablet computer devices and 32% with e-reader devices

(2) It is also interesting to note that 70% of teens (13–17 years old) and 79% of young adults (aged 18–24) are owners of smartphones

c. According to Nielsen's Digital Consumer Report, social media is well integrated into the fabric of everyday life

(1) The Digital Consumer Report documented that 64% of social media users log in at least once a day and almost 50% log into their social network on their smartphone on a daily basis

(2) "Mobile devices are certainly driving the growth in social media, as social media app usage increased 37% in 2013 compared to last year"

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Digital Tools in Education and Practice

1. Overview

a. To better understand the tools being used in the Connected Age, it is important to define social media

(1) In some cases, social media is used as the broad category that encompasses all of the Web 2.0 tools

(2) Anthony Bradley in his blog offered a new definition, "social media is a set of technologies and channels targeted at forming and enabling a potentially massive community of participants to productively collaborate … enable collaboration on a much grander scale and support tapping the power of the collective in ways previously unachievable"

(3) According to Bradley, there are six defining characteristics that distinguish social media from other collaboration and communication IT tools

(4) These characteristics are

- **i.** Participation
- **ii.** Collective
- **iii.** Transparency
- **iv.** Independence
- **v.** Persistence
- **vi.** Emergence

(5) Participation echoes the "wisdom of the crowds" concept, but note that there is no wisdom if the crowd does not participate

(6) The term *collective* refers to the idea that people collect or congregate around content to contribute, rather than the way individuals create and distribute content in the Web 1.0 world

(7) Transparency refers to the fact that everyone can see who is contributing and what contributions are made

(8) Independence refers to the anytime, anyplace concept; people can participate regardless of geography or time

(9) Persistence refers to the notion that information or content being exchanged is captured and not lost as in a synchronous chat room

(10) Lastly, "the emergence principle embodies the recognition that you can't predict, model, design, and control all human collaborative interactions and optimize them as you would a fixed business process"

(11) Taken together these characteristics define the new world of social media

2. Blogs

a. In the Connected Age, social writing and communication are important concepts for sharing resources and ideas as well as for making connections with people similar to you

(1) Social writing can take many forms and include, but are not limited to, wikis, blogs, and microblogging

(2) Blogs, short for Weblogs, are considered to be personal Web sites where content is displayed for visitors to review and comment upon

(3) A top listing of health-related blogs are available at the following Web site: http://labs.ebuzzing.com/top-blogs/health

(4) The Health Care Social Media List, maintained by the Mayo Clinic's Social Media Health Network, documents the types of social media being used by hospitals across the United States

    - **(5)** There statistics demonstrate although blogs were once very popular, there are fewer blogs being maintained by hospitals
    - **(6)** Of the 1544 hospitals only 209 have blogs

3. Wikis

- **a.** Wikis are coined after the Hawaiian work for fast, and are a means to establish an easily and quickly accessed consumer-driven knowledge base; they are essentially collaborative tools that are "based on social regulation rather than technical safeguards"
    - **(1)** Wikis, as a form of social writing, are also prevalent in healthcare
    - **(2)** CliniWiki is a popular wiki targeted toward clinical informatics topics
    - **(3)** This wiki contains information on a variety of topics in such areas as clinical decision support systems, unintended consequences of technology, federal initiatives, and usability
    - **(4)** Professional organizations, such as HIMSS also maintain a Decision Support Wiki
    - **(5)** An interesting educational Web site in informatics is the University of Edinburgh's Informatics wiki that is focused primarily on educational opportunities, student projects, discussions, and resources
    - **(6)** Another important wiki is of course the ever popular Wikipedia that maintains over 4 million articles

4. Microblogging

- **a.** Microblogging, the combination of texting and blogging adds a new dimension to communication and social writing and is growing in popularity
    - **(1)** Historically, electronic mail (e-mail), instant messaging, and text messaging, have been less public forms of communication
    - **(2)** These forms have been seen as one-to-one communication
- **b.** Microblogging, using such tools like Twitter now allow consumers to post content to a Web site, which then automatically distributes the content to others who have "subscribed" to the individual's site; this creates short bursts of communication among any number of individuals
    - **(1)** These microblogging sites allow social communication to come directly to consumers, rather than requiring that consumers go and seek it out themselves
    - **(2)** These short bursts of communication, known as Tweets, are limited to a specific number of characters (140)
    - **(3)** In education, Twitter is being used in various ways

Teaching Tip
One example is when conference participants tweet information being presented at the conferences to their students.

- **c.** Educators are also using Twitter in the classroom to encourage student engagement
- **d.** In healthcare, there is a rise in the use of microblogging especially in the public health arena
    - **(1)** According to Eysenbach, "Infodemiology can be defined as the science of distribution and determinants of information in an electronic medium, specifically the Internet, or in a population, with the ultimate aim to inform public health and public policy"
    - **(2)** The electronic medium can be supply driven, such as the information being published in
        - **i.** Blogs
        - **ii.** Microblogs
        - **iii.** Discussion groups
        - **iv.** Demand driven that includes Web searching and navigation

Teaching Tip
Some examples of the use of Twitter include its use in tracking trends in health behaviors: physical activity, dietary, smoking, and prescription drug abuse. Other uses include dissemination of vital information during disasters and documentation of the extent of crisis such as the H1N1 or SARS viruses.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Social Networking

1. Overview

- **a.** Social networking embraces many of the defining characteristics of the Connected Age and is a major component of connected learning and connected health
    - **(1)** First, participation and collaboration were two of the principle themes in Web 2.0 and are the driving forces behind the social media movement with continued relevance in the Connected Age
    - **(2)** Eysenbach further noted, "Social networking … involves the explicit modeling of connections between people, forming a complex network of relations, which in turn enables and facilitates collaboration and collaborative filtering processes"
    - **(3)** Another aspect of social networking is the ability to share user-generated content in the form of videos, stories, or photographs
    - **(4)** In addition to adding and viewing content, consumers can also post comments to media someone else has contributed, thus adding another level of communication to these sites
- **b.** Of the available digital tools, social networking offers the most opportunity for peer support and consumer engagement
    - **(1)** Users can make connections with people that they already know in person or may connect with others through associations that they create
    - **(2)** Essentially, the social networking site serves as a powerful tool to engage and motivate consumers to share personal information, establish relationships, and communicate with others
- **c.** This is definitively exemplified in the phenomenal growth of social networks such as Facebook

- **(1)** Facebook celebrated its tenth anniversary in 2014 and is considered the dominant social networking site where 57% of adults and 73% of teens (12–17 years old) used Facebook
- **(2)** According to a recent Pew Research Center study, despite the growing number of adults using Facebook on a daily basis, the younger generation "are not abandoning the site"
- **(3)** Here are some additional facts about Facebook
  - **i.** Although users dislike some aspects of Facebook (sharing too much personal information and posting photos without permission), the users do not want to miss out on social activities
  - **ii.** Second, 47% like the ability to share photos and videos with friends as well as sharing with many people at the same time
  - **iii.** They also like updates from their friends and humorous content
  - **iv.** Third, 50% of adult users have over 200 friends on Facebook
  - **v.** Fourth, younger rather than older users have "unfriended" a person
  - **vi.** Fifth, although most users do not change their status on Facebook, they do like to comment on friend's postings
  - **vii.** Lastly, those that do not use Facebook are still familiar with Facebook through their family members

d. Higher education, including healthcare professional education, is taking full advantage of the collaborative features of social networks and mobile access to create dynamic and collaborative learning experiences

- **(1)** The dynamic nature of collaboration via the Internet offers learners the opportunities to share working knowledge, provide professional support, and create communities of learning
- **(2)** Social media compliments and supports e-learning opportunities where students are able to have more control over the pace, sequence, and timing of their learning experience

e. These new digital learning environments aim at deepening the level of engagement for the student experience and also allows students to connect to a vast array of accessible resources, knowledge, expertise, and social connections

Teaching Tip

In the field of informatics, Skiba and Barton described the use of social networking tools at the University of Colorado College of Nursing. In this graduate program, they have embraced the use of social media not only to engage and retain online learners but also to attract potential students to the program. The program incorporates various social media, such as social networking and virtual worlds, as part of the online learning environment.

Teaching Tip

Another example is the University of Oregon Biomedical Informatics program that includes the use of blogs to connect students and faculty within their programs. More recent applications of social networks are appearing as universities and specific programs form LinkedIn groups of their graduates or current students. In nursing education, one of the best known social networks was Meet Stella Bellman, a mannequin in a simulation lab at Mesa Community College and was used to connect and communicate with nursing students.

f. Healthcare institutions and consumers have already begun to capitalize on the limitless utility of social networking

- **(1)** Numerous hospitals and healthcare-related organizations have social networking sites where patients and visitors can explore details about the facility, learn more about available services, and find information about diseases and/or treatments
- **(2)** Of the available social networking sites, Facebook stands out as one of the more popular, as it has proven useful for resource sharing, communication, and collaboration
- **(3)** According to the Mayo Clinic's Center for Social Media List, of the 1544 hospitals using social media, there are 1292 hospitals that have Facebook social networks and 651 that have LinkedIn groups
- **(4)** To learn more about the top hospitals that are social media friendly, you can visit the rankings of hospitals conducted by MHdegree.org
- **(5)** At the top of the list are
  - **i.** Mayo Clinic
  - **ii.** Cleveland Clinic
  - **iii.** University of Texas MD Anderson Cancer Center
  - **iv.** Mt Sinai Medical Center
  - **v.** The University of Michigan Hospitals and Health Centers

2. Social network

a. One of the first social networks in healthcare was Matthew Zackery's i2y social network (I am too young for this Cancer Foundation)

- **(1)** At one of the first Health 2.0 conferences, Zackery presented his experiences in creating the social network targeted for young adults with cancer
- **(2)** To learn more, you can visit the following Web site: http://stupidcancer.org/

b. The Center for Disease Control (CDC) has embraced the use of social media and was used extensively in their H1N1 campaign

- **(1)** The CDC site not only connects people to the CDC, but also to other social networks such as Facebook, My Space, and Daily Strength
- **(2)** It provides videos, podcasts, e-cards, widgets, RSS feeds, and the ability to get text messages and join their Twitter subscription
- **(3)** Their Web site contains a variety of resources that are used such as current campaigns as well as a Social

Media Toolkit to help people create their own social media campaigns

c. Perhaps one of the most interesting and well-researched social networking sites is PatientsLikeMe
  - **(1)** Through this social network, patients from all over the world convene and share their experiences while dealing with chronic conditions such as Multiple Sclerosis
  - **(2)** The creators' brother, who was living with amyotrophic lateral sclerosis (ALS), was the inspiration for the network
  - **(3)** Two brothers and a friend, all Massachusetts Institute of Technology engineers, created this network with the following goals in mind
    - **i.** Share health data
    - **ii.** Find patients with similar conditions
    - **iii.** Learn from each other
  - **(4)** Patients are asked to share data in the hope of improving the lives of all diagnosed with that particular disease
  - **(5)** The site currently supports over 250,000 members, over 2000 health conditions, over 40 published research studies, and over 1 million treatment and symptom reports
  - **(6)** The site does not have any fees and is kept free from advertising through revenues stemming from research awareness programs, market surveys, and the sale of processed anonymized data
  - **(7)** Members use aliases rather than real names and can openly share details about their healthcare experiences, drug regimens, and treatment side effects
  - **(8)** The primary motives behind such sharing are to ask or offer advice and to build a relationship with others in similar situations
  - **(9)** "Rather than disseminating medical advice, PatientsLikeMe serves as a platform for peers to interact with one another in a data-driven context"
  - **(10)** Patients have actually taken information they have learned from PatientsLikeMe to their own healthcare providers to request to be put on specific treatments
  - **(11)** More recently, PatientsLikeMe has launched a Data for the Good Campaign to encourage patients to share their health data to advance healthcare research

d. A recent report by the eHealth Initiative with funding from the California Healthcare Foundation, examined the use of social media to prevent behavioral risk factors associated with chronic disease
  - **(1)** According to this report, "By seeking and sharing information online, health consumers (or 'e-patients') are using social media to become more equipped, enabled, empowered, and engaged in managing their health, care, and wellness"
  - **(2)** Although healthcare providers continue to play a primary role in the provision of health information, "more Americans than ever value social networks (e.g., friends, family members, and fellow patients) for emotional support and advice on everyday health issues"
  - **(3)** Healthcare is in essence becoming more social
  - **(4)** Fox summarized it as "Peer-to-peer health care is a way for people to do what they have always done—lend a hand, lend an ear, lend advice—but at internet speed and at internet scale"

e. The eHealth Initiative Report developed a specific taxonomy to classify social media tools for chronic diseases
  - **(1)** This taxonomy includes such tools as
    - **i.** Internet support groups
    - **ii.** Media sharing
    - **iii.** Messaging boards/discussions
    - **iv.** Microblogs
    - **v.** Social networking general and specific to a particular disease
    - **vi.** Weblogs
    - **vii.** Social games
    - **viii.** Challenges

f. Grajales, Sheps, Ho, Novak-Lauscher, and Eysenbach conducted a narrative review of social media and its use in healthcare
  - **(1)** They reviewed 76 articles, 44 Web sites, and 11 policy reports to derive 10 categories of social media
    - **i.** Blogs
    - **ii.** Microblogs
    - **iii.** Social networking sites
    - **iv.** Professional networking sites
    - **v.** Thematic networking sites
    - **vi.** Wikis
    - **vii.** Mashups
    - **viii.** Collaborative filtering sites
    - **ix.** Media sharing sites
    - **x.** Virtual worlds
  - **(2)** They found that social media was fairly extensive, there was a need to begin to address challenges related to
    - **i.** Governance
    - **ii.** Ethics
    - **iii.** Professionalism
    - **iv.** Privacy
    - **v.** Confidentiality
    - **vi.** Information quality

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Mobile Health

1. Overview
  - **a.** As new tools are introduced in healthcare, it is not only changing the delivery of care, but it is changing the dynamics of healthcare and the interactions between consumers and their providers

   (1) This is particularly true as one explores the growing of mobile devices and apps that allow for Connected Health interactions
   (2) World Health Organization defines mobile health or mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices
   (3) mHealth involves the use of voice and short messaging service (SMS) as well as more complex functionalities such as 3G systems, global positioning systems (GPS), and Bluetooth technology"

b. The use of smartphones has greatly impacted the mHealth arena

   (1) Smartphones allow consumer and patients to use mobile health applications
   (2) Most mobile apps are available through mobile store platforms like Apple App Store, Google Play for the Android
   (3) There are also more than 100 apps approved by the FDA for use in healthcare
   (4) In a Pew Internet and American Life Study of Mobile health, they found that 52% of smartphone users accessed health information from their phones
   (5) This was particularly true for adults who were Latino, African American, between the ages of 18 and 49
   (6) Users with a college degree or being a caregiver, especially for someone that had a recent medical crisis were also good indicators of accessing health information through their smartphones
   (7) The study also found, although there were many healthcare apps available, only about 18% of smartphones users use these apps to track or manage their health
   (8) The most frequently used health apps were for exercise, diet, or weight apps

c. A more recent study conducted by the IMS Institute for Healthcare Informatics analyzed healthcare apps to assess their value

   (1) Over 40,000+ healthcare apps from the Apple iTunes app store were downloaded
   (2) After several iterations of exclusions, a total of 14,243 apps related to consumer health
   (3) These apps were classified according to the patient's journey: prevention/healthy lifestyles, symptoms or self-diagnosis, finding a healthcare provider or facility, education post diagnosis filling prescriptions, and compliance
   (4) The majority of apps were in the overall wellness category (prevention and healthy lifestyles) with diet and exercise being the dominant apps
   (5) In terms of functionality, most apps were limited in their functions, with most providing just information
   (6) According to the report, "there is a subset of apps with impressive functionality (e.g., electrocardiogram [ECG] readers, blood pressure monitors, blood glucose monitors)"
   (7) In addition, only one-fifth track or capture consumer-initiated data
   (8) Most of the apps have fewer than 500 downloads and five apps account for 15% of all health app downloads
   (9) Although there are some apps that cover the total patient's journey and can be therapy or demographic specific, there is a disconnect between apps available and the population of older adults and seniors who have the most healthcare needs
   (10) As smartphone users increase in these age groups so may the apps available to them

d. Another source of free healthcare apps is the Department of Health and Human Services Digital Strategy for Mobile apps site

   (1) Here you can find a variety of apps from the
      i. CDC
      ii. National Institutes of Health
      iii. National Cancer Institute
      iv. National Library of Medicine
   (2) These apps are available for multiple operating systems and across multiple devices like smartphone or tablets

e. In addition to consumer available apps, there is also a group of medical apps that are approved by the FDA

   (1) According to the FDA, there are several types of mobile apps that required to be regulated
   (2) The first category is mobile apps that transform a mobile platform into a regulated medical device (light, vibrations, camera, or other similar sources to perform medical device functions and are used by a licensed practitioner to diagnose or treat a disease)
   (3) The second category is apps that connect to an existing device type for purposes of controlling its operation, function, or energy source (such as implantable or body worn medical devices)
   (4) The last category refers to apps that display, transfer, store, or convert patient-specific medical device data from a connected device
   (5) To read more, go to: http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/ConnectedHealth/MobileMedicalApplications/ucm368743.htm
   (6) To review a list of mobile medical apps approved by the FDA, go to: http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/ConnectedHealth/MobileMedicalApplications/ucm368784.htm

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Benefits of Social Media

1. Overview

a. To understand the benefits of social media, it is important to examine the growing number of studies over time

    - **(1)** In the past, most studies were descriptive. In a review by Skiba, Guillory, and Dickson, there are three general areas of research in social media
    - **(2)** The first focused primarily on the content being shared on social media, in particular social networks and Twitter
    - **(3)** The second area was the specific use of social media by patient populations such as diabetics or cancer patients
    - **(4)** The final area was related to the use of social media for recruitment of patients for research studies and the collection of data from social media could be used as an additional form of research data
    - **(5)** Some interesting findings were that Facebook, YouTube, and Twitter were the most common social media platform and PatientsLikeMe was the most studied network to date
  - **b.** More recently, there have many more research studies, including clinical trials that have examined the impact of social media tools on patient care
    - **(1)** The growth of these studies has generated several systematic reviews to provide evidence for the use of these tools in promoting and managing various patient populations

Teaching Tip
Here is a sampling of some systematics studies. Moorehead et al. completed a systematic review to examine the uses, benefits, and limitations of social media for health communications. Capurro et al. conducted a systematic review of social networking sites for public health practice and research. Chang, Chopra, Zhang, and Woolford analyzed studies on the role of social media in online weight management. Maher et al. conducted a systematic review of the effectiveness of behavior change interventions through social networks. Most found promising results, but there was a need for additional studies.

  - **c.** The eHealth Initiative Report concluded that social media provides a multitude of benefits to patients by "enabling health education and enhancing behavior by
    - **(1)** Breaking down the walls of patient–provider communication
    - **(2)** Improving access to health information
    - **(3)** Providing a new channel for peer-to-peer communications
    - **(4)** Developing meaningful relationships
    - **(5)** Establishing communities of patients, caregivers, and family members
    - **(6)** Engaging and empowering people"
  - **d.** The development and continuing research in the use of social media will expand and more studies will continue to provide additional evidence of their effectiveness
    - **(1)** There is little doubt that the social life of healthcare will continue
    - **(2)** Despite their prospects, digital tools in the Connected Age do not come without certain limitations and risks
    - **(3)** Like any element of our digital environment, they pose concerns for privacy, security, and legal issues

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Challenges of Social Media

1. **Overview**
  - **a.** According to the eHealth Initiative, there are several key challenges affecting the widespread adoption of social media in healthcare
    - **(1)** First, there are concerns about privacy and HIPAA compliance
    - **(2)** There are also concerns about the balance of transparency and anonymity associated with the sharing of personal information online
    - **(3)** The quality, validity, reliability, and authenticity of information are an issue especially when there is user-generated information
    - **(4)** There is also the challenge of the digital divide specifically with differing populations such as the elderly, minorities, the disabled, those living in rural areas, and those in poor or undeserved areas without access to broadband
  - **b.** The final challenge in this report also mentions the lack of theoretical and evaluation models for social media given the paucity of effectiveness data
    - **(1)** Grajales et al. also echo many of the same challenges, "The potential violation of ethical standards, patient privacy, confidentiality, and professional codes of practice, along with the misrepresentation of information, are the most common contributors to individual and institutional fear against the use of social media in medicine and health care"
  - **c.** The Connected Age places unique circumstances around the sharing of protected health information, as it is generally patient, student, or consumer-driven
    - **(1)** That is, the consumer voluntarily divulges his or her information
    - **(2)** In such cases the HIPAA regulations do not apply, however, healthcare institutions' attempts to abide by the law may hinder their adoption of Web 2.0 applications
    - **(3)** The sharing of personal information is also an issue with the use of social media by students
    - **(4)** It is not just the sharing by healthcare professional students of their own information in social networks but also the potential of them sharing personal health information of their patients on social networks
    - **(5)** Such was the case of nursing students posting a picture of a patient's placenta
  - **d.** There are also concerns about privacy and confidentiality
    - **(1)** Their concerns are not unfounded since the rates of identity theft are on the rise and Internet security cannot ever be fully ensured
    - **(2)** Social media applications promote information sharing and the open display of personal information, such as age, gender, and location

- **(3)** Posting this and other content creates digital footprints, or lingering information that can be connected back to the consumer who provided it; these bits of information can then be found and coalesced to form a more complete picture of the individual, thus negating the apparent transparency supposed by Web 2.0 applications
- **(4)** A recent study conducted by Grajales et al. found there are worries about sharing data, many US adults (94%) are willing to share their health data to improve care and believe that data sharing can help other patients as well as themselves
- **(5)** Users of social media are at risk for social threats as well
- **(6)** Characterized as stigmatizing and bullying, social threats can pose significant dangers to consumers and those with whom they are affiliated

e. In addition, there may be legal issues related to risk management and liabilities

- **(1)** It has long been known that Internet content is not regulated and may be unreliable
- **(2)** Healthcare and educational organizations in the Connected Age must also be cognizant of the legal implications
- **(3)** Not only will they have to monitor the content being shared on their site for appropriateness, reliability, and quality of their information, they will also need to be sure there are no copyright infringements
- **(4)** Healthcare practice licenses are also an issue considering that in the Connected Age, there are no real geographic boundaries

f. The digital divide, or gap in usability, exists for some consumers who either lack physical access to the Internet or do not have knowledge or skills to navigate the myriad information on the Internet safely and effectively

- **(1)** Physical access limitations can be described as lack of resources to obtain the hardware or software to utilize these tools
- **(2)** Lack of experience describes the knowledge and skill deficit that hinders a consumer's ability to navigate tools effectively and safely
- **(3)** Some have also found that ethnic disparities do exist in regard to Internet access but, surprisingly, not in regard to social media use

g. As with most innovations, these challenges can be partially addressed through the development and implementation of social media policies by organizations, including user-generated networks

- **(1)** This is particularly important given that most healthcare agencies are risk adverse regarding patient care
- **(2)** Professional organizations, such as American Nurses Association, American Medical Association, and the National Council of State Boards of Nursing have provided guidance and social media policies
- **(3)** Barton and Skiba also present social media policy recommendations for educational institutions
- **(4)** The Mayo Clinic Center for Social Media provides resources related to social media policies

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- There is no doubt that digital tools have transformed the world around us
- By providing digital tools to students, healthcare professionals, and consumers, we are transforming healthcare education and practice
- The addition of mobile devices facilitates the continuous use of social media tools in every aspect of our lives
- In the Connected Age, learners can create their own learning pathways as they seek knowledge and skills in either formal higher educational degree programs or in professional development
- For consumers, patients, and their families, the Connected Age provides opportunities for them to become more engaged in their healthcare decisions by expanding their connections from just family and friends to a cadre of other patients/consumers who are like them as well as a community of healthcare professionals that are experts in their particular health or disease conditions

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe the evolution of the Internet and the movement toward the Connected Age
- Describe the use of social media and mobile tools in healthcare education and practice
- Identify the challenges and issues related to the use of social media in healthcare education and practice

Teaching Tip
Ask the students to define the keywords

- Connected Age
- Digital tools
- Social networking
- Social media
- Mobile apps

CHAPTER REVIEW QUESTIONS

Question 45:1: Identify the implications of the computer and communications revolution on the world. True or False?

a. The Internet revolutionized the communication infrastructure of users True ___ False ___

b. The World Wide Web is not considered to be a "browser" True ___ False ___

c. The Connected Age refers to the interconnection of everything and everyone True ___ False ___

d. The Internet was funded by NSF for interconnecting networks True ___ False ___

e. The Web does not allow users to view text, images, or multimedia True ___ False ___

Question 45.2: What is the difference between the "Internet" and the "Web"?

a. The Internet was considered as an application that supports a system of interlinked hypertexted documents and the Web was considered to be a network of interconnected computers across the globe

b. The Internet was developed and offered by DARPA for federal usage whereas the Web was offered by NSF to the academic community

c. The Internet is a network of interconnected computers across the globe and the Web is an application that supports a system of interlinked hypertexted documents

d. The Internet linked computer sites whereas the Web was a software protocol designed to access computer sites

Question 45.3: The Web 2.0 was introduced at a 2004 conference brainstorming session about the failures of the dot-com industry. What were the new features that separated it from Web 1.0?

a. The Web 2.0 was considered a dissemination vehicle, it was viewed as a platform rather than an application, and it provided rich user experiences

b. The Web 2.0 was viewed as a platform rather than an application, it was achieved by harnessing the collective intelligence of the users, and it provided rich user experiences

c. The Web 2.0 was viewed as a platform rather than an application, it was achieved by harnessing the collective intelligence of the users, and it was considered a dissemination vehicle

d. The Web 2.0 was viewed as a platform rather than an application, it was considered a dissemination vehicle, and it provided rich user experiences

Question 45.4: The "Connected Age" was introduced in higher education. What features does it have that have advanced the academic environment?

a. It offers new ways to connect things that were previously "un-connectable" True ___ X False ___

b. It is about creating a whole that is greater to the sum of its parts True ___ X False ___

c. Digital tools are primarily associated within the broad concepts of social media and mobile applications True ___ X False ___

d. It includes three revolutions: broadband mobile connectivity, the rise of social media, and social networking in everyday life True ___ X False ___

e. It is used for only online education True ___ False ___ X

Question 45.5: What best describes social media platforms?

a. Facebook is considered to be the best and dominant social network platform

b. Mobile devices are preventing the growth of social media into everyday life

c. Social media has the same characteristics as communication IT tools

d. Social writing such as wikis or blogs is not usable as social media

Question 45.6: What are the six defining characteristics that distinguish social media from other collaboration and communication IT tools?

a. Collective, reliability, transparency, independence, persistence, and emergence

b. Participation, transparency, independence, persistence, reliability, and emergence

c. Reliability, participation, collective, independence, persistence, and emergence

d. Participation, collective, transparency, independence, persistence, and emergence

Question 45.7: Which of the lists below is considered to be a type of social writing?

a. Blogs, Web site, Twitter, and Facebook

b. Wikis, Twitter, Facebook, and blogs

c. Twitter, blogs, Web site, and Internet

d. Facebook, Web site, blogs, and Twitter

Question 45.8: What are examples of social networking?

a. It supports e-learning opportunities for students

b. It presents the level of engagement for student experience

c. It allows students to connect with a vast array of accessible resources, knowledge, expertise, and social connections

d. It supports virtual worlds as part of online learning environment

Question 45.9: What are the benefits of social media in online and e-learning education?

a. The dynamic nature and collaboration via the Internet offer students the opportunities to share working knowledge, provide professional support, and create communities of learning True ___ X False ___

b. The social media complements and supports e-learning opportunities where students are able to have more control over the pace, sequence, and timing of their learning experience True ___ X False ___

c. It deepens the level of engagement for the faculty supervision and class development True ___ X False ___

d. Allows students to connect to a vast array of accessible resources, knowledge, expertise, and social connections True ___ X False ___

e. In the field of informatics the use of social networking tools to engage and retain online learners as well as attract students into the program True ___ X False ___

Question 45.10: What are the challenges of widespread social media adoption in healthcare as presented in an eHealth Initiative Report in 2014?

a. Ignoring the issues of privacy and HIPSS compliance True ___ False ___ X

b. The balance of anonymity associated with the sharing of personal information online True ___ X False ___

c. The quality, validity, reliability, and authenticity of information when there is user-generated information True ___ X False ___

d. Challenges of the digital divide specifically with differing population groups True ___ X False ___

e. Lack of theoretical and evaluation models given the paucity of effectiveness data True ___ X False ___

ANSWERS AND EXPLANATIONS

Question 45:1:

a. The Internet revolutionized the communication infrastructure of users True ___ X False ___

b. The World Wide Web is not considered to be a "browser" True ___ X False ___ X

c. The Connected Age refers to the interconnection of everything and everyone True ___ X False ___

d. The Internet was funded by NSF for interconnecting networks True ___ X False ___

e. The Web does not allow users to view text, images, or multimedia True ___ X False ___

There is no doubt the Internet provided the necessary infrastructure to revolutionize the way scientists and researchers from the worlds of academic, business, and government could share data, interact, and collaborate with each other.

Question 45.2: (c) The Internet is a network of interconnected computers across the globe and the Web is an application that supports a system of interlinked hypertexted documents. The name "Internet" refers to global seamless interconnection of networks made possible by protocol devised in the 1970 through DARPA-sponsored research. One uses the Internet to connect to the Web. A Web browser allows the user to view Web pages that contain text, images, and other multimedia.

Question 45.3: (b) The Web 2.0 was viewed as a platform rather than an application, it was achieved by harnessing the collective intelligence of the users, and it provided rich user experiences. The introduction of Web 2.0 embodies the long history of community spirit of the Internet conceived by its originators. It is as much a collection of communities as a collection of technologies, and its success is largely attributed to satisfying basic community needs as well as utilizing the community effectively to push the infrastructure forward.

Question 45.4:

a. It offers new ways to connect things that were previously "un-connectable" True ___ X False ___

b. It is about creating a whole that is greater to the sum of its parts True ___ X False ___

c. Digital tools are primarily associated within the broad concepts of social media and mobile applications True ___ X False ___

d. It includes three revolutions: broadband mobile connectivity, the rise of social media, and social networking in everyday life True ___ X False ___

e. It is used for only online education True ___ False ___ X

Question 45.5: (a) Facebook is considered to be the best and dominant social network platform. Facebook is a social network that involves the explicit modeling of connection between people, forming a complex network of relations which in turn enables and facilitates collaboration and collaborative filtering process. Facebook celebrated its tenth anniversary in 2014 and is considered a dominant social networking site.

Question 45.6: (d) Participation, collective, transparency, independence, persistence, and emergence. Participation echoes "wisdom of the crowds"; collective refers to the ideas that people collect or congregate around content to contribute; transparency refers to the fact that everyone can see who is contributing and what contributions are made; independence refers to the anytime, anyplace, concept; persistence refers to the notion that information or content being exchanged is captured and not lost; and emergence principle embodies the recognition that you can't predict, design, and control human collaborative interactions.

Question 45.7: (b) Wikis, Twitter, Facebook, and blogs. The list presented is considered to be forms of social writing. Social networking involves the explicit modeling of connections between people, forming a complex network of relations which in turn enables and facilitates collaboration and collaborative filtering processes.

Question 45.8: (c) It allows students to connect with a vast array of accessible resources, knowledge, expertise, and social connections. Of the available digital tools, social networking offers the most opportunity for peer support and consumer engagement. Users can make connections with people that they already know in person or may connect with others through associations that they create.

Question 45.9:

a. The dynamic nature and collaboration via the Internet offer students the opportunities to share working knowledge, provide professional support, and create communities of learning True ___ X False ___

b. The social media complements and supports e-learning opportunities where students are able to have more control over the pace, sequence, and timing of their learning experience True ___ X False ___

c. It deepens the level of engagement for the faculty supervision and class development True ___ False ___ X

d. Allows students to connect to a vast array of accessible resources, knowledge, expertise, and social connections True ___ X False ___

e. In the field of informatics the use of social networking tools to engage and retain online learners as well as attract students into the program True ___ X False ___

Social media complements and supports e-learning opportunities where students are able to have more control over the pace, sequence, and timing of their learning experience.

Question 45.10:

a. Ignoring the issue of privacy and HIPSS compliance True ___ False ___ X

b. The balance of anonymity associated with the sharing of personal information online True ___ X False ___

c. The quality, validity, reliability, and authenticity of information when there is user-generated information True ___ X False ___

d. Challenges of the digital divide specifically with differing population groups True ___ X False ___

e. Lack of theoretical and evaluation models given the paucity of effectiveness data True ___ X False ___

Others also echo many of the same challenges, “The potential violation of ethical standards, patient privacy, confidentiality, and professional codes of practice, along with the misrepresentation of information are the most common contributors to individual and institutional fear against the use of social media in medicine and healthcare.”

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A Paradigm Shift in Simulation: Experiential Learning in Virtual Worlds

• OBJECTIVES

1. Describe the use of Virtual Worlds (VW) such as Second Life (SL) as simulated learning.
2. Discuss the pedagogy that drives teaching and learning in the VW.
3. Create a supportive learning environment for educational innovation in VW.
4. Describe common applications to enhance learning in the VW.
5. Discuss future trends for learning in the VW.

• KEY WORDS

Virtual Worlds (VW)
Second Life (SL)
Simulation
Online education
Informatics education
Health professional education
User computer interface

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: What is a virtual world? Can you give examples? Do you participate in a virtual world? Can you describe your avatar? How could a virtual world be used for education purposes? Can you give examples? How could a virtual world be used in healthcare? Can you give examples?

For a WIIFM statement, say to the class, "This chapter discusses educational application of virtual worlds with particular emphasis on Second Life. Second Life, a 3-dimensional (3D) virtual world developed by Linden Lab and uniquely imagined and created by its residents was launched in 2003. SL is considered the largest virtual world with tens of millions of square meters of virtual land and more than 36 million registered users. Currently, SL is the most mature and popular virtual world platform being used in education; however, there are several dozen virtual worlds, giving SL serious competition, though most are still small and even the largest does not come close to matching SL's massive land and user base. Over the past decade, a large number of colleges and universities have established a presence in SL. These efforts are largely for teaching courses, but also include recruitment activities for prospective students, fund raising, and research endeavors. Today, disenchanted with commercial virtual worlds, but still convinced of their educational value, some institutions have started to build their own environment, where they have more control over the learning space." As a nurse, it is important to understand how a virtual world can be used in education as well as healthcare.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
    a. Hundreds of leading schools and universities across the globe use virtual worlds (VW) such as Second Life (SL) as an innovative part of their educational courses and programs
        (1) Online virtual worlds have multiple uses for teaching and learning
        (2) This environment enhances student engagement with course content and develops a sense of community among and between students and faculty
        (3) This virtual environment creates a powerful platform for interactive experiences that brings new dimensions to support best practices for learning
        (4) In this virtual environment, students and faculty can work together from anywhere in the world, giving education a global perspective and an expanded reach
    b. The major challenge for online education is student engagement and the evaluation of skill attainment
        (1) Virtual worlds provide an online, virtual laboratory that addresses this challenge
        (2) Faculty and student avatars can interact with each other, physically and verbally, in real time, thus facilitating simulations where students engage in demonstrating skill acquisition
        (3) Faculty are able to coach the skill development, as they now control the environment and can see what the student is doing
        (4) This type of evaluation in a real or simulated environment was previously unattainable in an online course
        (5) Furthermore, the virtual environment provides a forum for student presentations and interactions with a live audience
        (6) Field trips to other virtual environments create opportunities to hone skills in information searching and observation of activities and settings that can be viewed by the faculty and other students
        (7) This virtual learning environment can adapt and grow to meet different user needs and is limited only by one's imagination and creativity
    c. This chapter discusses educational application of virtual worlds with particular emphasis on SL
        (1) SL, a 3-dimensional (3D) virtual world developed by Linden Lab and uniquely imagined and created by its residents was launched in 2003
        (2) SL is considered the largest virtual world with tens of millions of square meters of virtual land and more than 36 million registered users
        (3) Currently, SL is the most mature and popular virtual world platform being used in education; however, there are several dozen virtual worlds, giving SL serious competition, though most are still small and even the largest does not come close to matching SL's massive land and user base
        (4) Over the past decade, a large number of colleges and universities have established a presence in SL
        (5) These efforts are largely for teaching courses, but also include recruitment activities for prospective students, fund raising, and research endeavors
        (6) Today, disenchanted with commercial virtual worlds, but still convinced of their educational value, some institutions have started to build their own environment, where they have more control over the learning space

Instructor Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Teaching and Learning in Virtual Worlds

1. **Overview**
    a. The use of virtual worlds expands teaching and learning opportunities for campus-based and online classes
        (1) Teaching in a virtual world differs from teaching a traditional online course due to the 3D setting, the use of avatars to represent the participants, and the sense of presence
        (2) The degree of immersion and interactivity available in virtual worlds allows for a greater sense of presence which is believed to contribute to meaningful learning, especially when the course is online
        (3) Virtual worlds such as SL facilitate real-time interaction between faculty and students when they are geographically apart
        (4) Furthermore, the environment can be controlled or simulated to create learning experiences designed by the faculty member to achieve pedagogical goals
        (5) These planned learning environments previously had to be in one physical place (e.g., learning laboratories, clinical facilities)
        (6) SL supports online education by moving the geography to a virtual space, thus creating a sense of presence for the faculty and students
        (7) The sense of presence is important for learner engagement, regardless of whether the experience is real or virtual
        (8) *Presence* is defined as "the subjective experience of being in one place or environment, even when one is physically situated in another"
        (9) When in-world, the students feel as if they are actually in the virtual environment
        (10) A sense of immersion is also necessary for learning
        (11) *Immersion* is the sense of being enveloped by and interacting with the environment
        (12) While *involvement* is "a psychological state experienced as a consequence of focusing one's energies and attention on a coherent set of stimuli or meaningfully related activities and events"
        (13) SL activities and simulations create a presence and immersion for faculty and students, whether they are in traditional classes or online classes
        (14) The lack of a sense of presence has always been a major critique of online education

    - **(15)** Now there is a tool that minimizes the sense of isolation and distance
  - **b.** Faculty use virtual worlds for learning activities that require students to exercise higher order thinking
    - **(1)** Students can create, apply, analyze, synthesize, and problem-solve using course content and previous knowledge
    - **(2)** Teaching strategies include: role-play, gaming, simulation of social and clinical skills, collaboration, social networking and participation in live events such as lectures, conferences, and celebrations
    - **(3)** Faculty are finding that they can stage clinical simulations, guide students through the inside of cell structures, or present other imaginative teaching exercises that cannot be done in "real life" due to cost, scheduling, location, or safety issues
    - **(4)** The truth is we do not know all the possibilities of what we can and cannot do with this tool for education yet
    - **(5)** There are active educational special interest groups, conferences, and listservs enabling faculty to share pedagogical strategies, ideas, and simulations
    - **(6)** As Knapfel, Moore, and Skiba recommend continued research is needed to explore best practices for use of VWs in education and practice

Instructor Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Pedagogy of Teaching in the Virtual World

1. Overview

  - **a.** Although it is not the purpose of this chapter to discuss learning theory in detail, it is important to know there are several learning theories that support teaching and learning in virtual worlds
    - **(1)** Technology for teaching and learning should always be selected to fit with the pedagogy
    - **(2)** First, consider the goals for the course and then select the technology tools and strategies that will help to meet the proposed outcomes
  - **b.** To begin with, learners in SL are adults and, therefore, Malcom Knowles' theory of andragogy provides an overarching framework for designing learning activities for adult learners
    - **(1)** Andragogy is based on the following assumptions about adult learners
      - **i.** Adults are self-directed, goal oriented, and need to know why they are required to learn something
      - **ii.** They approach learning as problem-centered rather than content-centered
      - **iii.** They need to recognize the value of learning and how to incorporate that learning into their jobs or personal lives
      - **iv.** They learn best through experiential learning that incorporates their diverse life experiences in the development of new knowledge
    - **(2)** Since adult learners take a great deal of responsibility for their own learning, this greatly alters the role of the faculty in learning environments in general but especially in virtual worlds such as SL
    - **(3)** It should also be noted that environments like SL are well suited to applying the assumptions of adult learning theory; however, teachers and learners must adapt to this paradigm shift and to this new environment
  - **c.** Other learning theories utilizing the principles of andragogy that educators most frequently apply to SL are experiential learning theory, social learning theory, constructivism, connectivism, and collaborative learning theory
    - **(1)** Many of these theories have overlapping principles that can be mixed and matched to enhance best practices in education
    - **(2)** Technology advancement and social networking tools such as SL provide rich learning environments for developing and facilitating learning activities that promote the use of these theories
    - **(3)** In the authors' opinions, no one model fits best as it will depend on the goals of the course as well as the teaching and learning style of the faculty and students
    - **(4)** Also, some components of a particular theory may not be satisfied in a virtual world like SL
    - **(5)** Today, although explosive, only the tip of the iceberg is being seen by colleges, universities, and training programs using VWs
    - **(6)** As the trend continues to grow in popularity, educators and researchers will realize the expansion of current theories as well as new theories and patterns of learning will be developed

2. Designing the learning space

  - **a.** Working in virtual worlds is not always intuitive
    - **(1)** Faculty need to rethink how the course material is structured and delivered
    - **(2)** They need technical assistance to help with complex instructional design decisions that are congruent with the pedagogy, teaching strategies, and outcomes
    - **(3)** Faculty should not be expected to be the technology experts; rather, they should team up with an IT professional for design and delivery support associated with technical training and technical issues
    - **(4)** As a team they will work together to adopt and integrate this technology as an innovative practice for teaching, learning, and research
    - **(5)** The challenge that faces faculty is determining the various nuances of their audience, understanding the content, determining the best approach to deliver the content, and developing a comfort level with the technology
  - **b.** Commonly, the virtual world learning space is designed to replicate the traditional learning space
    - **(1)** Areas are developed to support broadly defined educational activities
    - **(2)** These virtual areas typically include a large lecture hall or auditorium for presentations, smaller classrooms for discussion, an exhibition hall for displaying student work, and faculty office space for meeting with students

(3) However, this real-world approach to virtual world learning space brings with it similar constraints on the types of teaching and learning that can happen in those spaces

Instructor Tip

For example, large lecture halls, whether in the real world or the virtual world, are based on objectivist approach to course design, and such spaces do little to support more collaborative and constructivist learning approaches.

(4) Gerald and Antonacci suggest that in addition to designing spaces to meet traditional learning needs, the majority of the learning space can be designed to meet specifications for course projects

(5) These spaces might include a home to practice assessing and remediating disability issues, a community living center as the context for database development, an operating room simulation for learning complex medical procedures, a health clinic for interacting with simulated patients and interprofessional team members, or perhaps a grocery store, restaurant, and exercise facility for teaching learners healthy living skills

(6) Let the course or project goals and your creativity guide the design

(7) Here are some things to consider in designing the learning space

3. Orientation

a. Calongne points out that although it is tempting to begin a virtual world class with an orientation to the software and the virtual world itself, students need action and excitement to help them envision how the technology will enrich their learning experience

(1) She recommends that faculty sell the benefits first and then discuss how it works

(2) Begin with exciting examples from other classes or research projects to make the experience real, personal, and engaging; then, provide a brief introduction demonstrating how to use the tool effectively

(3) Keep in mind that in higher education, not all students are created equally

(4) Creating an avatar and figuring out how to move, look around, and interact with others may be a challenge for some students, but not all

(5) Getting everyone to the in-world class site may require extra time initially, so plan for it, and you may want to provide alternative communication support for added assistance, if needed

(6) Finally, if some students are hesitant, mitigate any fears or risks associated with using the technology and create a safe learning environment

b. Orienting students to virtual worlds should follow the precepts of experiential learning

(1) The SL Web site has very clear directions for downloading the portal to the environment and then leads the individual through creating an avatar

(2) Encourage students to engage in this experience of downloading software and creating an avatar by letting them know they are developing health informatics competencies

(3) An orientation to participating in SL is also needed

Instructor Tip

Within directions for this exercise, a possible statement to achieve this purpose may be: “Second Life is an immersive virtual environment. An avatar is a user’s self-representation in the form of a 3-dimensional model. In Second Life, creating your avatar is part of how you will interact with other residents. Some people design their avatar as a life-like representation of self. As the popularity of Second Life grows, many professional meetings occur in this virtual world; please dress you avatar in casual or professional clothes. The user controls the avatar through the use of the mouse or keyboard to walk, fly, and sit. An avatar can interact with other avatars through instant messages or the audio function (using a headset).”

(4) Once the avatar is created there are several video tutorials to teach students how to navigate their avatars in SL, see Table 46.1 for suggestions

(5) Upon completion of the tutorials, the faculty and student avatars should be ready to enter SL

(6) Students need to feel competent enough with the technology to carry out required task and to meet the learning objectives

(7) Basically, they should be able to move, look around, customize avatars, and interact with each other

(8) During the first SL activity, a support person, knowledgeable in SL technology, should be available to troubleshoot problems with software and microphone use

(9) After the first SL experience, students are ready to engage in more activities and openly share their enthusiasm for this type of interaction

(10) As faculty begin to envision more activities, they will need additional support to make this happen without having to take time to become experts in using and building in SL

4. Course design

a. Virtual worlds use a mix of media-rich course materials selected to correspond to the learning activities and the students’ learning needs

(1) Learning activities are experiential and can be designed to be synchronous or asynchronous, allowing students to interact with the subject matter to study, discuss, create, and express their views of the content under the supervision of the faculty member

(2) The faculty’s role shifts from the authoritative expert to that of the dominant expert who stimulates and supervises exploration while providing structure, guidance, feedback, and assessment

(3) Virtual worlds provide immense opportunities for innovation and cultivate new ways to meet higher order learning

(4) Rather than lecture, the class activity may involve teams of students taking a virtual field trip, gathering information, and later submitting their assignment through an SL group chat space or by collaboratively

creating a presentation, a project management plan, or some other scholarly product to illustrate application, analyses, synthesis, or evaluation of the learning

(5) The exemplars that follow describe one institution's design principles and learning activities

Instructor Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Exemplars of Learning in Second Life

1. **The University of Kansas experience**
   - **a.** The University of Kansas Medical Center (KUMC) is organized into three major schools: Medicine, Nursing, and Health Professionals
     - **(1)** These schools are supported by the Department of Teaching and Learning Technology (TLT) located within the Division of Information Resources
     - **(2)** TLT's mission is to provide leadership and support for the successful integration of new and existing educational technologies across KUMC learning environments
     - **(3)** One of these technologies is SL, which KUMC faculty use for communication, presentations, immersive learning activities including simulation and role playing, and research projects
     - **(4)** The staff in the TLT department began exploring and researching the SL virtual world in 2004, just after it was released from beta
     - **(5)** Struck by the educational potential of this new learning space, TLT staff began working with interested faculty to connect real-world course content with virtual world learning activities
     - **(6)** Because of the interest expressed by faculty in the nursing informatics, nursing anesthesia, as well as the physical and occupational therapy programs, KUMC administrators in 2007 decided to purchase its own island or private space and named it KUMC isle
     - **(7)** An island or private region allows for restricted access and other levels of control not available on the virtual mainland
     - **(8)** Faculty worked closely with TLT to establish goals and objectives for teaching in SL and to get started by building the necessary learning space
     - **(9)** Collaboration among the campus academic programs helps to set standards and creates academic environments that are efficient and effective as well as model the real-world academic environment
     - **(10)** Building on the success experienced in health informatics, physical therapy, and nurse anesthesia, other KUMC programs began to use SL to enhance learning and conduct research studies
2. **Graduate health informatics program**
   - **a.** Learning to be a health informaticist requires developing skills identifying use cases and workflows in clinical environments
     - **(1)** These are experiential skills and are difficult to master in an online environment
     - **(2)** Simulations and clinical experiences are the traditional approaches for teaching these skills, yet are not feasible in online courses where students reside in multiple states and time zones
     - **(3)** Virtual reality environments, like SL, provided the online platform for simulations to experience and practice informatics skills
     - **(4)** SL was selected as the simulation environment for our online health informatics graduate program
     - **(5)** These simulations facilitate the development of informatics competencies for future work environments
   - **b.** The curriculum, among other skills, teaches information system design and database development. An SL simulation was constructed to facilitate learning these skills
     - **(1)** The faculty designed the Jayhawk Community Living Center (JCLC), an assisted living facility, for the simulation
     - **(2)** The JCLC was designed to include rooms for six residents, a day room, dining room, clinic room, nurses' station, medical records room, medication room, director's office, and conference room
     - **(3)** Landscaping, including a deck over the water surrounding KUMC Island, was built to enhance the reality of the simulation (Fig. 46.1)
     - **(4)** Cues and artifact concerning information system requirements were placed in various locations within the JCLC so that students learned to observe the environment
     - **(5)** Some of these cues were multiple telephones for residents, computer locations for staff, and floor plans for workflows
     - **(6)** Faculty played the roles of Director of Nursing and staff nurse
   - **c.** The purpose of one particular simulation is to design a fall-risk management information system for the JCLC
     - **(1)** This would be the first electronic health record for the JCLC
     - **(2)** Students are given a Request for Proposal (RFP) and information about falls: evidence-based protocols, workflows and policies for the management of fall risk, and resident data concerning fall risk
     - **(3)** Their first task is to meet with the Director of Nursing in the JCLC conference room to clarify the requirements for the information system
     - **(4)** This meeting is conducted through text messaging within SL so that a transcript of the meeting is available for analysis (Fig. 46.2)
   - **d.** Next the students are taken on a tour of the JCLC, as they would be in real life, to observe and ask questions to clarify the requirements for the fall-risk information system
     - **(1)** Students must design the entire system—architecture, software, Internet access, security and confidentiality constraints, and other relevant system functions
     - **(2)** The deliverables for the design are storyboards, use cases, use-case diagrams, workflow diagrams, and activity diagrams for both current and future states

- **e.** In the database theory course, the students return to the JCLC to design and build an access database for the fall-risk management assessments
  - **(1)** They must work with the staff again to determine database table structures (conceptual, logical, and physical data models), data entry forms, standard data queries, required reports, and training needs
  - **(2)** This time the cues are very important, as the students must realize that each resident has two telephones that must be in the database as well as other physical cues regarding data collection and input
  - **(3)** This is a common problem in database design. Information concerning each resident is posted on a "Touch Me" card outside the resident's room (Fig. 46.3)
  - **(4)** The database produced by the students must contain all the information and address each design challenge embedded in the simulation
- **f.** Students enjoy the experience, request more class time in SL, and successfully develop informatics projects
  - **(1)** SL is a great way to simulate a facility so students can learn to elicit user requirements for information systems
  - **(2)** The challenges are scheduling meeting times, managing group interactions, practicing etiquette in group interactions, and learning to use the technology of SL
- **g.** Students present posters in SL as a way to demonstrate learning
  - **(1)** Many of the presentations are about usability and design issues, system security approaches, federal regulations impacting the discipline of informatics, database management systems, and so forth
  - **(2)** The simulation helps them to learn to put together a poster and answer questions of attendees at the poster session
  - **(3)** A poster pavilion module was created with six poster boards (Fig. 46.4)
  - **(4)** This module can be recreated to host as many presenters as is required

3. Course evaluations

- **a.** A serendipitous finding in using SL was using The Beach on KUMC isle as a place to celebrate the end of a course and for students to share with faculty what worked and what didn't work
  - **(1)** Early on, students suggested adjourning to the beach after the last class
  - **(2)** Faculty facilitated the meeting and engaged the students in informal discussions about the use of SL
  - **(3)** Students shared their enthusiasm for SL and then began to share perspectives on the course
  - **(4)** The informal environment, outside the course, encouraged very productive discussions that lead faculty to change several course strategies
  - **(5)** Now, after every course, a Beach Party is conducted to debrief the course
  - **(6)** Students continue to be very professional in their desire to help the courses evolve into highly successful experiences
  - **(7)** The Beach is shown in Fig. 46.5

4. Use of Second Life in doctoral nursing courses

- **a.** During the first semester, all doctoral students enroll in a technology and informatics course
  - **(1)** This course is designed to assist the student in developing skills to complete an online doctoral program
  - **(2)** SL is one of several Web 2.0 programs introduced to the students
  - **(3)** Formal presentations of team projects are required
  - **(4)** Students use instant messaging and SL to meet as a team to organize the work of their projects, thus enhancing their informatics skills
  - **(5)** The presentations are conducted in the amphitheater, using microphones and speakers
  - **(6)** Students are able to see the audience, pace the presentation, and answer questions just as they would in the real world
  - **(7)** These students also enjoy the Beach Party at the end of the course and have helped make this course very popular (Figs. 46.6, 46.7, and 46.8)

5. Nurse Anesthesia program

- **a.** TLT staff in collaboration with faculty in the Nurse Anesthesia program developed a virtual world operating room simulation to assist first-year Nurse Anesthesia students with learning the basic induction procedure
  - **(1)** Nurse Anesthesia faculty members were already experienced with physical patient simulators, such as SimMan; however, they were especially interested in virtual simulations, since a large amount of their program trains students in different processes and procedures
  - **(2)** The objective of this project is to learn how the operating room is organized, to navigate the environment, to learn workflow and organizational skills, and to practice the basic induction procedure before stepping foot in the real-life operating room
  - **(3)** The SL operating room is designed to look exactly like the operating room at KU Hospital (Fig. 46.9)
  - **(4)** The clocks and the tables and the other objects are in the same locations as they are in the real operating room
  - **(5)** This creates the ability for students to be exposed to the layout of the operating room before they experience the real environment
  - **(6)** Some of the equipment in the SL space is designed to be interactive so the students can manipulate them and gain confidence
  - **(7)** To view how the student progresses through the learning activity and how the objects interact with each other, view the video tutorial of the Second Life Operating Room

6. Physical and occupational therapy program

- **a.** The physical and occupational therapy faculty partnered with TLT staff to develop virtual home environments in SL (Figs. 46.10 and 46.11)
  - **(1)** The home environment is a critical part of everyday life and participation in activities of daily living and instrumental activities of daily living
  - **(2)** The homes were designed with a focus on objects within the home to assist students to identify environmental

barriers and support, and to make critical decisions regarding environmental and task modification for clients

  - **(3)** The student learning outcomes include interprofessional collaboration, patient-centered decision making, and appreciation of the environmental and social context of functional mobility and occupational performance
- **b.** Physical and occupational therapy students working in teams use SL to evaluate the home of a disabled client. There are a series of three homes with different hazards to be identified
  - **(1)** Students are given a patient record with information concerning the patient's abilities and disabilities
  - **(2)** They then conduct a walk through and make recommendations for creating a safer home environment
  - **(3)** Faculty control the visual cues and hazards, and so know when the students make accurate assessments
  - **(4)** Once students make the recommendation, the TLT staff modified the home, according to the recommendations and faculty and peers evaluate the modifications based on levels of support, unintended challenges, and client preferences
  - **(5)** Seeing the outcomes of their recommendations is a step that is usually not able to be accomplished in the real world because students are not always able to see their modifications carried out

7. Dietetics and nutrition weight management program

- **a.** A faculty researcher in the Department of Dietetics and Nutrition saw a presentation by a faculty member in occupational therapy who was teaching a class in SL, and immediate thought this would be a good environment to use for weight management
  - **(1)** Sullivan's research team studied 20 overweight and obese people in a program that involved either real-life or virtual reality meetings every week for 3 months
  - **(2)** At the end of that period, all the subjects took part in a weight-maintenance program using SL
  - **(3)** Sullivan found that while virtual reality compares favorably with face-to-face interactions in controlling weight loss, its true benefits were more readily apparent in weight maintenance
  - **(4)** In the study, participants created avatars that could interact with the other cyber-dwellers in the group
  - **(5)** Training and education took place on KUMC isle
  - **(6)** Participants used headsets and microphones to communicate with others within the group
  - **(7)** Since SL can automatically work with Web sites like YouTube to pull in content to use within the simulation, during meetings of the avatars in a virtual conference room, group leaders could show videos or present other materials
- **b.** KUMC's original island environment included a conference room, house, gymnasium (Figs. 46.12 and 46.13), grocery store (Fig. 46.14), restaurant, and buffet
  - **(1)** Each space provided the avatars with a setting to interact with each other as well as to check on calorie counts in food items, calories burned during exercise, and other helpful information
  - **(2)** By using SL participants can simulate real-life situations without many of the consequences and repercussions that occur in real life
  - **(3)** For example, the avatars can practice meal planning complete with calorie counts for items in the grocery store, dining out or attending holiday parties, all in the anonymity of cyberspace
  - **(4)** The goal of the simulation is to create a friendly environment where people can spend time researching healthier lifestyles without the fear of being judged
  - **(5)** As a result of Sullivan's preliminary research, she and her team received a grant from the National Institutes of Health to continue the research
  - **(6)** Through this grant KUMC created a new island KUMC Healthy U
  - **(7)** The new island expands opportunities for the participants
  - **(8)** On KUMC Healthy U, avatars will be able to take advantage of restaurants with cashiers that total the amount of calories on customers' trays as they check out
  - **(9)** A kiosk, known as Fast Food Frenzy, links avatars to the Web sites of various restaurants, which allows them to calculate the calories in their meals
  - **(10)** The new island also includes a more elaborate gymnasium, complete with a swimming pool where avatars can register the calories burned as they swim, tread water, or take part in activities in the water
  - **(11)** Trainers in the gym are able to help the research subjects by answering basic fitness questions
  - **(12)** Avatars can also access fitness videos while doing their simulated running on treadmills
  - **(13)** One of the highlights of the new island is trails where avatars can walk, run, or bike while SL keeps tabs on the calories burned
  - **(14)** All participants in this study will receive the same weight-loss program for 6 months and then be randomized to either virtual reality or remain with a traditional method for 12 months of weight-loss maintenance
  - **(15)** The overall aim is to compare the difference in weight-loss maintenance between the two groups
  - **(16)** The resources developed in SL for this research project are also used by other faculty to meet their course objectives
  - **(17)** For example, informatics students have developed smartphone apps that can be used for weight loss and maintenance
  - **(18)** Undergraduate students can be assigned to shop in the virtual grocery store or dine in the many restaurants to learn about healthy food choices
  - **(19)** Virtual worlds are valuable new research tools to study human behavior
  - **(20)** Researchers can inexpensively prototype models and explore data visualization in unique ways

8. **Administrative considerations: Creating a supportive environment**
    a. Educational innovation is a process of bringing new teaching strategies to satisfied learners and future knowledge workers
        (1) It is a conversion of new knowledge into value-added outcomes, enhanced by novel teaching strategies
        (2) Innovation in education involves not only technological advances, but also pedagogical approaches
    b. Most innovative educators are recognizing and experimenting with the educational possibilities of virtual worlds
        (1) Also, student enthusiasm for these learning formats is strong, creating uniquely powerful, interactive, and compelling educational possibilities
        (2) At the same time, for many faculty members, teaching in SL can be daunting
        (3) Learning the new technology, meeting the needs of the technologically diverse students, understanding virtual reality pedagogy, and managing workload and time are some of the challenges
        (4) It is up to academic administrators to provide the support and resources to encourage faculty to use new technologies such as Second Life and other emerging technologies
        (5) The goal is to minimize organizational barriers to student and faculty success
        (6) Challenges at the organizational level need to be anticipated and policies, procedures, and guidelines should be in place to help mitigate their impact on faculty and students
        (7) Faculty who desire to use SL, need to be heard, to feel supported, and to have an infrastructure in place that not only supports the present, but allows for growth and rewards faculty's efforts
        (8) Creating a supportive environment for successful adaptation of innovative teaching strategies requires resources, but, more importantly, it requires a cultural shift for many academic institutions
9. **A culture of innovation**
    a. As technology advances, today's learning environment needs to convey a culture of innovation and strategically plan to meet the challenge of change
        (1) Every academic organization has a culture; the issue is whether and how that organization supports innovation
        (2) A culture of innovation gives you a competitive edge because it makes you more nimble with an increased ability to respond to change
        (3) To be successful, a culture of innovation should reflect a balance between an openness to allow ideas to flow, and the creation of controls and supports around those ideas
    b. Academia is steeped in a tradition of hierarchical beliefs where research and scholarship is rewarded and educational innovation is not
        (1) To fully integrate a culture of innovation within the organization, key concepts of innovation need to be reflected in the organization's mission, vision, leadership, core values, hiring practices, metrics, rewards, and compensation
        (2) The concepts call for new interactions and partnerships involving a team approach to teaching, learning, and research
        (3) Also, success requires clear communication from leadership that describes how the institution understands educational innovation and that understanding should be built into the organizational behavior and modeled by the leader
        (4) Faculty and staff should feel comfortable and supported to take risks without fear of failure or retribution
        (5) As Melnyk and Davidson point out, "success in an innovative culture is viewed as going from one failure to the next with enthusiasm"
10. **Strategic planning and support for innovation**
    a. In the early 1990s, the KUMC Division of Information Resources, in collaboration with the Schools of Medicine, Nursing, and Allied Health, and the Division of Continuing Education, embarked on a strategic planning process to position the academic environment for the new wave of technology-based education
        (1) This planning process resulted in the formation of a reenvisioned academic support department—the Department of Teaching and Learning Technologies (TLT)
        (2) The department is housed within the KUMC Information Resource Division. Central to its mission, the department has evolved over time to support new and diverse technologies, providing cutting edge technology tools for faculty and students
        (3) KUMC faculty, staff, students, and community have dependable access to core teaching and learning technologies as well as the knowledge, skills, and support to be successful with these tools
        (4) They are also aware of promising new technologies, and have both the technical and pedagogical support to explore and evaluate the educational possibilities of these tools
        (5) As technologies mature, those with the greatest potential to enhance teaching and learning are integrated into our core technologies, establishing a pattern of innovation and success
        (6) This infrastructure, which includes four instructional designers and three technology specialists, has served the Medical Center campus well over the ensuing years as educational technologies advanced and became more affordable and acceptable
        (7) Key to KUMC's success is the partnership between faculty and the TLT staff to design, develop, and implement courses using enhanced technologies and to work collaboratively across KUMC academic programs to develop a community of technology educators who share ideas and challenge each other
11. **School of Nursing administrative support**
    a. The School of Nursing (SON) administration fully supports teaching in SL and serves as a liaison between the faculty and the TLT administrator to assure academic innovation and maintain quality and integrity of academic programs

  - **(1)** Clear communication about faculty's pedagogical needs is essential to good outcomes and assures faculty the support they need
  - **(2)** Faculty who are champions in this new learning environment need to be encouraged to take risks and should be rewarded for their efforts
  - **(3)** To demonstrate its commitment to innovation, the SON revised its appointment, promotion, and tenure criteria, using Boyer's model of scholarship, to reflect the value of innovation in education, practice, and research
  - **(4)** Boyer proposed an expanded definition of *scholarship* within the professoriate based on four functions: discovery, integration, application, and teaching
  - **(5)** He argues that all forms of scholarship should be recognized and rewarded, and that this will lead to more personalized and flexible criteria for gaining tenure
  - **(6)** Boyer proposes using "creativity contracts" that emphasize quality and innovation in teaching, while fostering professional growth that supports individuals and their passions
  - **(7)** A balanced focus on all forms of scholarship is critical to meet the challenges in creating and sustaining innovative academic programs
  - **(8)** Using this model, faculty are encouraged, supported, and rewarded for risk taking, pilot testing, and design thinking in their teaching practices

- **b.** The technology service support in the SON is another example of administration's support for the use of SL and other technology-supported practices
  - **(1)** These services include an advanced technology environment for all faculty and staff, coordinated with all of the services at the KUMC campus level
  - **(2)** The SON supports two dedicated professionals who exclusively serve the technology needs of the school
  - **(3)** The lead person is a network engineer who manages the school's file servers and other advanced technologies and is assisted by a person who provides local desktop assistance, database programming, and videoconferencing assistance to assist faculty teaching with a wide variety of technologies
  - **(4)** The school's support staff also provides services such as notebook computer support for faculty and staff, assistance in purchasing hardware and software to support research and educational innovation, and assistance with mobile computing devices. Teaching in SL requires a computer with hefty specs to run properly
  - **(5)** Through these technology services and futuristic planning, the SON assures that faculty have what it takes to successfully teach in SL (see Table 46.2 for resources)

- **c.** Faculty are the most important factor in the overall success of using SL and innovative teaching strategies
  - **(1)** If faculty feel well supported (technology, design, administrative) and have a voice in determining policies and procedures for fostering innovative environments, they will be more willing to move in-world with SL
  - **(2)** Specifically, faculty need training, professional development, and release time for initial increased workload and design issues
  - **(3)** Since faculty work collaboratively with instructional design and technology specialists, recognize that training needs shift from training faculty on software to training them on new teaching approaches, instructional design strategies, and workload management topics
  - **(4)** Keep in mind that virtual worlds may not be for everyone; work with your champions and let them be the driver and set the standard
  - **(5)** Celebrate your successes by having your champions showcase their work at faculty meetings and professional development sessions

Instructor Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

FUTURE TRENDS AND CONCLUSION

- Virtual worlds are environments that can provide valuable educational experiences for nursing and other health professions
- The degree of immersion and interactivity available provides a greater sense of presence and engagement, contributing to better learning outcomes in both in-person and online courses
- Faculty and staff are able to exercise their creativity to provide dynamic simulations for students in a novel, virtual world
- The outcomes are well worth the effort and resources required to produce high-quality learning experiences
- Virtual environments have extended the reach of educators into worlds without boundaries
- These worlds are free from self-imposed constraints and opened to new ways of thinking, imagining, expressing, and building
- Virtual worlds can provide many unique learning opportunities; however, it is important to use VWs not for the sake of using the tool, but for how the tool can facilitate learning
- Knapfel, Moore, and Skiba provide an excellent overview of the history of VWs and give examples of how several schools and organizations are using SL to support education and practice
- As computer power and networking speeds are evolving virtual spaces for learning will continue to advance
- The question is, are most educators ready to enter this space?
- Many faculty and administrators are not imaginatively equipped for what the technology can do or how to use it to enhance learning
- However, this may change as the "gamer" generation becomes more mature and able to recognize the value of an immersive learning from their past experiences
- Although this chapter focused on the use of SL, it is estimated that there are over 450 VWs
- Some educational institution, disenchanted with SL's pricing and policy change have switched to other platforms such

as OpenSim, ReactionGrid, OSgrid, and Active Worlds, to name a few

- These are evolving open source virtual reality online platforms
- However, as previously mentioned, most are still small and even the largest does not come close to matching Second Life's massive land and user base
- Each virtual world will have advantages and disadvantages
- When selecting a VW platform it is important to consider institutional needs, affordability, availability, usability, maintenance, and vendor stability
- SL has a large following of educators that share ideas, content, teaching strategies and collaborate across learning spaces
- It would be a shame to lose that cohesiveness as institutions become more scattered in their choice of virtual spaces
- As these other options for virtual space mature, it is important to advocate for interoperability to enable avatars as well as content to be transported from one virtual space to another
- Also, as these technologies continue to evolve and expand in use, it will be essential to conduct research to identify best practices for VW education and collaboration

Instructor Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Instructor Tip

Review the chapter objectives

- Describe the use of virtual worlds (VW) such as Second Life (SL) as simulated learning
- Discuss the pedagogy that drives teaching and learning in the VW
- Create a supportive learning environment for educational innovation in VW
- Describe common applications to enhance learning in the VW
- Discuss future trends for learning in the VW

Instructor Tip

Ask the students to define the keywords

- Virtual worlds (VW)
- Second Life (SL)
- Simulation
- Online education
- Informatics education
- Health professional education
- Virtual worlds
- User computer interface

CHAPTER REVIEW QUESTIONS

Question 46.1: What best describes an educational application in virtual worlds/Second Life?

a. Second Life is used for visiting alumni
b. Second Life uses robots to represent participants
c. Second Life facilitates student to student networking
d. Second Life supports online education by moving patient care to a virtual space

Question 46.2: What describes how faculty use virtual worlds/Second Life?

a. Activities that require students to exercise higher order of thinking
b. Strategies that include social skills
c. Clinical strategies to guide students on science courses
d. Teach exercises on negative behavior
e. Can participate in live events such as lectures, conferences, and celebrations

Question 46.3: What are some teaching and learning theories highlighted in virtual worlds/Second Life?

a. It uses technology tools based on the goals and theories of the course
b. It uses experimental learning, social learning, and collaborative learning theory
c. It promotes new patterns of living theory
d. It uses learning space theory to experience job training

Question 46.4: What areas should the faculty design and deliver versus what areas the IT experts should do to develop the educational materials for working in the virtual world?

a. They (faculty member with IT expert) need to work as a team as the design and delivery support associated with training and technical issues True ___ False ___
b. They need to work together to adopt and integrate this technology as an innovative practice for teaching, learning, and research True ___ False ___
c. They need to determine the best approach to deliver the content and develop a comfort level with the technology True ___ False ___
d. They each need to understand how the technology can emulate educational situations True ___ False ___ X
e. They each need to understand what are the criteria for a virtual world True ___ False ___ X

Question 46.5: Which describes the introduction of virtual world to students? True or False?

a. Orient students to the hardware used to enrich their learning experience True ___ X False ___

b. Teach students how to create an avatar to interact with others True ___ X False ___ X

c. Orient the students to virtual worlds through a field trip True ___ X False ___

d. Teach students to download the software and create an avatar True ___ False ___

e. Use video tutorials to teach students how to navigate their avatars True ___ X False ___

Question 46.6: Which best describes tools used to develop a virtual worlds course?

a. Select media-rich course materials for amusement

b. Design learning activities to be synchronous or asynchronous allowing students to interact with the subject matter

c. The faculty member serves as an authoritative expert and not as a dominant expert

d. Classes consist only of lectures

Question 46.7: In the exemplar of the KUMC learning using Second Life, what was the major educational strategy used?

a. It used SL to demonstrate NI technological skills

b. It used SL to teach students how a practice example would be in real life

c. SL provided the online platform for the simulations used to experience and practice informatics skills

d. It used SL to evaluate the care provided for a specific condition by the student

Question 46.8: How is SL used in the doctoral informatics nursing courses at KUMC?

a. Students used SL to meet and organize the NI team project

b. To test and implement the competencies of the nursing informatics courses

c. To evaluate the NI course content for outcomes

d. To develop the content for teaching NI strategies

Question 46.9: What are the four functions proposed in Boyer's definition of scholarship to reflect the value of faculty innovation?

a. Application, teaching, discovery, and model building

b. Discovery, integration, application, and teaching

c. Teaching, application, model building, and integration

d. Model building, discovery, integration, and teaching

Question 46.10: Why does SL provide valuable educational experiences for nursing faculty?

a. Better learning outcomes in both in-person and online courses True ___ X False ___

b. Faculty and staff are able to exercise their creativity to provide dynamic simulations for students in a novel virtual world True ___ X False ___

c. The outcomes are well worth the effort and resources required to produce high-quality learning experiences True ___ X False ___

d. Virtual environments have extended the reach of educators into worlds without boundaries True ___ X False ___

e. The virtual worlds are free from self-imposed constraints and opened to new ways of thinking, imaging, expressing, and building True ___ X False ___

ANSWERS AND EXPLANATIONS

Question 46.1: (d) Second Life (SL) supports online education by moving patient care to a virtual space. Faculty and student avatars can interact with each other in an online virtual laboratory that addresses this challenge. SL is an immersive virtual environment.

Question 46.2: (a) Activities that require students to exercise higher order of thinking. The students can create, apply, analyze, synthesize, and problem-solve using course content and previous knowledge. Faculty are finding that they can stage clinical situations, guide students through the inside of cell structures, or present other imaginative teaching exercises that cannot be done in "real life" due to cost, scheduling, location, and safety issues.

Question 46.3: (b) It uses experimental learning, social learning, and collaborative learning theory. There are several learning theories that support teaching and learning in virtual worlds. The teaching and learning should always be selected to fit with the pedagogy. First consider the goals for the course and then select the technology tools and strategies that will help meet the proposed outcomes.

Question 46.4:

a. They (faculty member with IT expert) need to work as a team as the design and delivery support associated with training and technical issues True ___ False ___

b. They need to work together to adopt and integrate this technology as an innovative practice for teaching, learning, and research True ___ False ___

c. They need to determine the best approach to deliver the content and develop a comfort level with the technology True ___ False ___

d. They each need to understand how the technology can emulate educational situations True ___ False ___ X

e. They each need to understand what are the criteria for a virtual world True ___ False ___ X

Commonly, the virtual world learning space is designed to replicate the traditional learning space for meeting with students.

Question 46.5:

- **a.** Orient students to the hardware used to enrich their learning experience True ___ X False ___
- **b.** Teach students how to create an avatar to interact with others True ___ X False ___ X
- **c.** Orient the students to virtual worlds through a field trip True ___ X False ___
- **d.** Teach students to download the software and create an avatar True ___ False ___
- **e.** Use video tutorials to teach students how to navigate their avatars True ___ X False ___

The goal is to create a safe learning environment. Orienting students to virtual worlds should follow the precepts of experimental learning.

Question 46.6: (b) Design learning activities to be synchronous or asynchronous allowing student to interact with the subject matter. Virtual worlds use a mix of media-rich course materials selected to correspond to the learning activities and students' learning needs.

Question 46.7: (c) Second Life (SL) provided the online platform for the simulations used to experience and practice informatics skills. The faculty used SL technologies for communication, presentations, immersive learning activities including simulation and role-playing and research projects. KUMC purchased its own island or private space. The faculty worked closely to establish goals and objectives for teaching SL and to get started by building the necessary learning space. Ultimately KUMC built programs for health informatics and other programs that enhanced learning and conducted research studies.

Question 46.8: (a) Students used SL to meet and organize the NI team project. Virtual reality environments, like SL provide the online platform for simulations to experience and practice informatics skills. The SL simulations facilitated the development on informatics competencies for future work environments. The curriculum among other skills teaches information system design and database development. The doctoral students enroll in technology and informatics course.

Question 46.9: (b) Discovery, integration, application, and teaching. Boyer argues that all forms of scholarship should be recognized and rewarded and that this will lead to more personalized and flexible criteria for gaining tenure.

Question 46.10:

- **a.** Better learning outcomes in both in-person and online courses True ___ X False ___
- **b.** Faculty and staff are able to exercise their creativity to provide dynamic simulations for students in a novel virtual world True ___ X False ___
- **c.** The outcomes are well worth the effort and resources required to produce high-quality learning experiences True ___ X False ___
- **d.** Virtual environments have extended the reach of educators into worlds without boundaries True ___ X False ___
- **e.** The virtual worlds are free from self-imposed constraints and opened to new ways of thinking, imaging, expressing, and building True ___ X False ___

Virtual worlds can provide many unique learning opportunities. However, it is important to use VWs not for the sake of using the tool, but for how the tool can facilitate learning.

PART 8

Research Applications

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Computer Use in Nursing Research

• OBJECTIVES

1. Describe general data and computer applications related to research in nursing, including proposal development and project implementation in both quantitative and qualitative research (*computer use in research*).
2. Summarize a range of computer-based, Web-innovations, tablet and mobile applications that facilitate or support the steps of the research process, including data collection, data management and coding, data analysis, and results reporting.
3. Compare and contrast select computer software applications that can be used in quantitative and qualitative research data analysis related to the steps of the research process.
4. Describe specific research studies in the literature that exemplify quantitative and qualitative methodologies on computer applications in healthcare.
5. Describe general categories of research that focuses on computer use in healthcare, from clinical applications and informatics integration to health and wellness (*nursing research on computer use*).
6. Introduce the new emphasis on "big data" and the growing interest in analysis of existing data to answer research questions on populations.
7. Describe the drivers for promoting informatics research and computer applications today for improving safety and quality of healthcare in the future (*research on nursing informatics*).

• KEY WORDS

Nursing informatics research
Research process
Research methodology
"Big data"
Quantitative
Qualitative
Data collection
Data mining
Data management
Data analysis
Research applications
Computer applications
Internet research
Secondary analysis
Meta-analysis

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Have you conducted or participated in a research study? Why is it important for nurses to conduct research? Can you give examples of nursing research? Can you explain the difference between quantitative and qualitative research? Have you used any statistical software? Have you used Excel to perform statistical analysis? Did you create any charts? Why is dissemination of research results important? What is meant by big data?

For a WIIFM statement, say to the class, "This chapter will provide an overview of the research process for two separate and fundamentally different research approaches—quantitative and qualitative—and discuss select computer applications and uses relative to these approaches. The discussion will be supplemented by examples of current science and the trajectory of research on the impact of informatics, electronic records, treatments, and integrated technologies using the computer as a tool. The objective of this chapter is fourfold: (1) to provide an overview of general computer and software applications related to the stages of the research process; (2) to describe how computers facilitate the work of the researcher in both quantitative and qualitative aspects; (3) to highlight research on computer use in healthcare; and (4) to give attention to the explosion of research in categories delineating clinical and nursing informatics research. These will serve as a snapshot of the research on computer use for the future with contextual influences. To begin, the chapter will focus on some of the considerations related to the logistics and preparation of the research proposal, project planning, and budgeting, followed by the implementation of the proposal with data capture, data management, data analysis, and information presentation." As a nurse, it is important to understand the research process including data analysis and dissemination.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
    a. Nursing research involves a plethora of tools and resources that researchers employ throughout the research process
        (1) From the individual or collaborative project initiation, through refinement of the idea, selection of approaches, development of methods, capturing the data, analyzing the results, and disseminating the findings, computer applications are an indispensable resource for the researcher
        (2) The investigators must be well prepared in a variety of computerized techniques for research activities as they are employed in the domain of knowledge that will be investigated
        (3) Without the power of technology, contemporary research would not reach the levels of sophistication required to discover and understand health and illness today
    b. In addition to the traditional approaches of the scientific method, researchers today have new avenues to explore in the development of knowledge
        (1) New opportunities to mine existing data for evaluation and discovery are forming a bridge between the process of conducting research and the products of discovery
        (2) New tools for automatic capture and analysis are changing the methods textbooks
        (3) New online strategies and apps are being implemented as the process of researching health and the product of researched interventions in health
        (4) From mobile applications that are downloadable to smartphones for researchers or patients or both, to tools for exploring large data sets that have been already captured, computer use in nursing has exploded concomitantly with computers in healthcare
    c. What is also of importance for computer use in nursing is the research on computerized applications and nursing informatics, which is revolutionizing how health information is documented in the Electronic Health Record (EHR) and producing pools of searchable secondary data waiting to be tapped
        (1) The context for nursing informatics research has proliferated since the National Institute of Nursing Research (NINR) published an agenda outlining the need for nursing informatics research in the Nursing Informatics Research Agenda
        (2) Other reports called for organizing priorities and constructing models to develop a context connecting nursing and informatics that would provide the basis for studying the practice of nursing informatics
        (3) Today, hospital wide information technology (IT) is the spine of all healthcare delivery, which is tied to reimbursement, and which inevitably forms the data engine that health systems put to work to research improvement and outcomes-driven questions
        (4) It is therefore imperative to understand the underlying terminologies and sources of data, communication of those connected pieces of information, and the elements in the nursing environments through informatics research if one is to understand how computers and nursing research coexist
    d. Outside the EHR and computerized health systems, in the rapidly changing world of Internet technologies, information management, and computer-enhanced intervention research on the use of computers has produced a new body of science that will continue to grow

   - **(1)** Blending the focus of computer use in research (tools and process) and research on computer use (informatics research) calls for an understanding of process and products
   - **(2)** This chapter will provide an overview of the research process for two separate and fundamentally different research approaches—quantitative and qualitative—and discuss select computer applications and uses relative to these approaches
   - **(3)** The discussion will be supplemented by examples of current science and the trajectory of research on the impact of informatics, electronic records, treatments, and integrated technologies using the computer as a tool

e. The computer has been a tool for researchers in many aspects of the research process and has gone beyond its historic application once limited to number crunching and business transactions

   - **(1)** Field-notes binders, ring tablets, index cards, and paper logs have all but disappeared in the researcher's world
   - **(2)** Personal computers (PCs), laptops, PC-tablets and iPads, and handheld devices have become part of the researcher's necessary resources in mounting a research project or study
   - **(3)** Wireless technologies are ubiquitous and connect people to people as well as researchers to devices
   - **(4)** Cloud computing today connects diverse enterprises with stable sources of software and data that can be shared or used by anyone, at any time, or any place
   - **(5)** Numerous enhancements have been added to the well-known text processing software products that reduce time and effort in every research office
   - **(6)** In addition, a wide range of new technologies for database management of subjects, contacts, or logistics have emerged in the research product marketplace
   - **(7)** Nurse researchers use a range of hardware and software applications that are generic to research development operations in addition to the tools and devices that are specific to research data collection, analysis, results reporting, and dissemination
   - **(8)** New apps appear continuously, customized to the data collection, management, or analysis process

f. In today's electronic healthcare environment, numerous advances have been made with the sources of data collection relative to general clinical applications in nursing, health, and health services

   - **(1)** System implementations for large clinical enterprises have also provided opportunities for nurses and health service researchers to identify and extract information from existing computer-based resources
   - **(2)** In an era when the federal government is calling for comparative effectiveness research (CER) to address the rising costs of healthcare, the richness of capturing nursing data that can be managed and mined for advanced analyses should be recognized in the development of EHRs and other sources

g. In addition, the era of Web-based applications has produced a wide range of innovative means of entering data and, subsequently, automating data collection in ways that were not possible before

   - **(1)** With the advancements in clinical systems, acceptable terminology and vocabularies to support nursing assessment, interventions, and evaluation, computers are increasingly being used for clinical and patient care research
   - **(2)** Although research is a complex cognitive process, certain aspects of carrying out research can be aided by software applications

Teaching Tip

For example, examination of nursing care/patient outcomes and the effect of interventions would have been prohibitive in the past, but with the aid of computers and access to large data sets, many health outcomes can be analyzed quantitatively and qualitatively.

   - **(3)** It is noteworthy when hospital systems today can use analytics across institutions with large samples of existing data to compare and predict best outcomes with select interventions, for example, examining preoperative procedures that minimize postoperative complications

Teaching Tip

In one hospital example, a procedure was changed with results from a rapid analysis of system-wide data, reducing mortality and morbidity related to postoperative complications. They went from asking the research question to implementing the procedural change in less than six months—change that in the past would have taken 17 years in randomized trials as has been reported.

h. With a wider view of computer use in nursing research, the objective of this chapter is fourfold

   - **(1)** To provide an overview of general computer and software applications related to the stages of the research process
   - **(2)** To describe how computers facilitate the work of the researcher in both quantitative and qualitative aspects
   - **(3)** To highlight research on computer use in healthcare
   - **(4)** To give attention to the explosion of research in categories delineating clinical and nursing informatics research

i. These will serve as a snapshot of the research on computer use for the future with contextual influences

j. To begin, the chapter will focus on some of the considerations related to the logistics and preparation of the research proposal, project planning, and budgeting, followed by the implementation of the proposal with data capture, data management, data analysis, and information presentation

   - **(1)** The general steps of proposal development, preparation, and implementation are applicable to both quantitative and qualitative approaches
   - **(2)** However, no discussion about computer use in research could be complete without acknowledging the range of

research now appearing in the literature that examines the trajectory of new technologies and computer use in patient care

(3) With increasing emphasis on cost and quality of healthcare, the computer-sources-of-data and computer-as-intervention must be part of understanding computer use in nursing research today

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Proposal Development, Preparation, and Implementation

1. **Overview**
   - **a.** All research begins with a good idea
     - **(1)** The idea is typically based on the nurse researcher's identification of a problem that is amenable to study using a philosophical and theoretical orientation
     - **(2)** The philosophical aspect sets the stage for selecting one's approach to investigating the problem or developing the idea
     - **(3)** Good clinical ideas often come from personal experiences, based on the researcher's foundation of knowledge that aids in drawing inferences from real clinical situations
     - **(4)** These unfold by way of iterative consideration of problem and process—leading the investigator to evolve an approach to the problem, and subsequently a theoretical paradigm to address the problem
     - **(5)** Because the theoretical paradigm emerges from these iterative considerations, and because the theoretical perspective will subsequently drive the organization of the research study, it is important to distinguish between these two distinct approaches
     - **(6)** Each theoretical paradigm directs how the problem for study will unfold
     - **(7)** The researcher uses a selected theoretical approach and operationalizes each step of the research process that will become the research design and methodology, either qualitative, quantitative, or some combination of both in mixed methods
     - **(8)** Each approach can be facilitated at different points along the proposal process with select computer applications
     - **(9)** These will be described as they relate to the methodology
2. **Quantitative or qualitative methodology**
   - **a.** The important distinction to be made between the quantitative and qualitative approaches is that for a quantitative study to be successful, the researcher is obliged to fully develop each aspect of the research proposal before collecting any data, that is, a priori; whereas, for a qualitative study to be successful, the researcher is obligated to allow the data collected to determine the subsequent steps as it unfolds in the process and/or the analysis
     - **(1)** Quantitative research is derived from the philosophical orientations of empiricism and logical positivism with multiple steps bound together by precision in quantification
     - **(2)** The requirements of a hypothesis-driven or numerically descriptive approach are logical consequences of, or correspond to, a specific theory and its related tenets
     - **(3)** The hypothesis can be tested statistically to support or refute the prediction made in advance
     - **(4)** Statistics packages are the mainstay of the quantitative methodologist, but are not the only connection to computers for the researcher
   - **b.** The qualitative approaches offer different research traditions (e.g., phenomenology, hermeneutics, ethnography, and grounded theory to name a few) that share a common view of reality, which consists of the meanings ascribed to the data such as a person's lived experiences
     - **(1)** With this view, a theory is not tested, but rather, perspectives and meaning from the subject's point of view are described and analyzed
     - **(2)** For nursing studies, knowledge development is generated from the participant's experiences and responses to health, illness, and treatments
     - **(3)** The requirements of the qualitative approach are a function of the philosophical frames through which the data unfold and evolve into meaningful interpretations by the researcher
     - **(4)** A variety of software applications assist the qualitative methodologist to enter, organize, frame, code, reorder and synthesize text, audio, video, and sometimes numeric data
3. **General considerations in proposal preparation**
   - **a.** Several computer applications have become indispensable in the development of the research proposal and generally in planning for the activities that will take place when implementing the study
     - **(1)** These include broad categories of office programs including word processing, spreadsheet, and database management applications
     - **(2)** According to Forrester Research, an independent research firm, Microsoft Office products currently capture 80% of users with 64% of enterprises using Office 2007
     - **(3)** Office 365 is the new release from Microsoft, programs with cloud capability that continue to offer improved clerical tools to manage the text from numerous sources and assemble them in a cogent and organized package
     - **(4)** The cloud connectivity gives researchers access to all programs and data virtually from anywhere. PC, Mac, and Droid tablets and smartphones extend the reach of all connectivity with a range of text processing and data management standard tools
   - **b.** Microsoft Office products provide capabilities and a platform into which other off-the-shelf applications can be integrated
     - **(1)** Tables, charts, and images can be inserted, edited, and moved as the proposal takes shape, with final products in publishable forms

(2) PC applications that allow inserting simple graphic designs give the researcher a powerful means of expressing concepts through art

(3) Line art and scanned images using Adobe industry standards such as Illustrator CC or Photoshop CC, now with cloud capability, can be integrated into the document for clear visual effects

(4) These offer the researcher and grants managers tools to generate proposals, reports, and manuscripts that can be submitted electronically directly or following conversion to portable document formats (pdf) using Adobe Acrobat or other available conversion products

c. There are a variety of reference management software products available as add-ons to word processing, with ranging prices and functionalities

Teaching Tip
For example, unique template add-ons give Microsoft Word additional power to produce documents in formatted styles.

(1) Bibliographic management applications emerge frequently and librarians often help sort out best ways to keep reference materials in order

(2) Common programs such as Reference Manager, Procite, and Endnote are products of the Thomson Corporation, the industry standard software tools for publishing and managing bibliographies on the Windows and Macintosh desktops

(3) RefWorks adds another option for reference management from a centrally hosted Web site

(4) Searching online is one function of these applications, and then working between the reference database and the text of the proposal document is efficient and easy, calling out citations when needed with "cite as you write" capability into the finished document

(5) Output style sheets can be selected to match publication or proposal guidelines

d. Research applications and calls for proposals are often downloadable from the Internet into an interactive form where individual fields are editable and the documents can be saved in a portable format such as Adobe Acrobat, printed, or submitted from the Web

(1) The Web also allows the researcher to explore numerous opportunities for designing a proposal tailored to potential foundations for consideration of funding

(2) Calls for proposals, contests, and competitive grants may provide links from Web sites that give the researcher a depth of understanding of what is expected in the proposal

(3) There are more and more homegrown submission procedures today for grants and journal manuscripts with Web-based instructions

(4) These often convert the documents automatically to portable formats (pdf) for submission with key data fields organized and sorted for easier review procedures. Instructions are customized for the user

4. Research study implementation

a. A funded research study becomes a logistical challenge for most researchers in managing the steps of the process

(1) Numerous demands for information management require the researcher to maintain the fidelity of the procedures, manage the subject information and paper flow, and keep the data confidential and secure

(2) These processes require researchers to use a database management system (DBMS) that is reliable

(3) Several DBMS software applications exist and have evolved to assist the researcher in the overall process of study implementation

(4) These applications are operations oriented, used in non-research programs and projects as well, but can assist the researcher in management of time, personnel, money, products, and ultimately dissemination, with reporting capability for reviews and audits

b. The ubiquitous Microsoft Office suite includes programs that manage data in a relational database (Microsoft Access) and number crunch in a flat database (Microsoft Excel) available to every researcher

(1) Proprietary database applications and new customized, more sophisticated, integrated, and proprietary database management applications from companies such as Oracle and Lotus provide the researcher with ways to operationalize the personnel, subjects, forms, interviews, dates, times, and/or tracking systems over the course of the project

(2) Most of these applications require specially designed screens that are unique to the project if the research warrants complicated connections such as reminders, but simple mailing lists and zip codes of subjects' addresses and contact information in a generic form can also be extremely useful for the researcher

(3) Some of these applications are beginning to include add-ons to increase application portability with devices such as the smartphones and tablets, and mini-tablets

c. Several other generic computer programs can aid the researcher in daily operations and project management

(1) Spreadsheet applications are invaluable for budgeting and budget planning, from proposal development through project completion

(2) One multipurpose Microsoft Office application is Microsoft Excel

(3) Universally understood and easy to use, Excel allows the researcher to manage costs and calculate expenses over the course of the project period, producing a self-documenting plan by categories to track actual spending and money left

d. Templates can be developed for repetitive tasks

(1) Scheduling and project planning software is also available from Microsoft including Microsoft Project that allows the project director to organize the work efficiently and track schedules and deadlines using Gantt charts over the lifetime of the project

(2) In more sophisticated research offices, customized tracking and data capture devices, programs and systems have been launched, including the exemplar of data management tools from the recent US Census that have captured and made data available to researchers with data tools

e. One other important consideration related to research proposal implementation for the seasoned researcher or the novice, doctoral dissertation investigator is the essential step of submitting the proposal to the Institutional Review Board (IRB)

(1) Home institutions that have IRBs will have specific procedures and forms for the researcher who can benefit from the proposal development electronically

(2) In some institutions, the IRB document management has been done through contracts with outside Internet organizations providing mechanisms for posting IRB materials, managing the online certifications required, and communicating with the principle investigators

Teaching Tip

One such example is IRBNet.org, hosting services for organizations to manage IRB and other administrative documents associated with the research enterprise.

f. In summary, the general considerations of developing and conducting a research study are based on philosophical approaches and will dictate which methodology the researcher will use to develop the study

(1) Although this will subsequently influence the research and computer applications to be used in carrying out the project, the steps of proposal preparation are less specific, and the computer applications are useful in both quantitative and qualitative studies

(2) After identifying the research problem, however, the researcher must proceed through the steps of the process, where computers play an important role that is unique to each of the methodologies

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Quantitative Approach

1. Data capture and data collection

a. Data capture and data collection are processes that are viewed differently from the quantitative and qualitative perspectives

(1) Nurses may already be familiar with data collection that is focused on the management of patient care

(2) Patient monitoring, patient care documentation, and interview data are collected by nurses, although not always for research purposes

(3) Data collection can take a number of forms depending on the type of research and variables of interest

(4) Computers are used in data collection for paper-and-pencil surveys and questionnaires as well as to capture physiologic and clinical nursing information in quantitative or descriptive patient care research

(5) There are also unique automated data capturing applications that have been developed recently that facilitate large group data capture in single contacts or allow paper versions of questionnaires to be scanned directly into a database ready for analysis or provided online with Web-based survey tools

b. ***Paper and pencil questionnaires***

(1) Paper and booklet surveys do still exist today in data collection, but new enhancements aid the researcher in time-saving activities

(2) Surveys and questionnaires can be scanned or programmed into a computer application either in a microcomputer or on a Web site accessed through the Internet

(3) Computers are being used for direct data entry in studies where subjects enter their own responses via a computer, and simultaneous coding of response to questions and time "online" can be captured or Web surveys can be distributed widely

(4) These online survey tools can provide a wide range of applications, including paper or portable versions, and range in price and functionality

(5) The use of notebook microcomputers, tablets, and mini-tablets have gained popularity in recent years for allowing the user to enter the data directly into the computer program at the time of the interview with a subject, with innovations emerging in touch screens, screen pens, and even wireless data entry with smartphones

(6) Responses to questions can be entered by the respondent or a surrogate directly into the computer or Web site through Internet access

(7) There are several research study examples where patients with chronic conditions used a computer application or the Internet as the intervention as well as the data capture device; patients or caregivers responded to questions directly and the data were processed with the same system

(8) Other examples of unique data capture in research include individual devices such as the "Smart Cap" used to measure patient compliance with medications

(9) The Medication Event Monitoring System (MEMS®6) (Fig. 47.11) automates digitized data that can be downloaded for analysis in research such as patient adherence studies

(10) A variety of online survey tools also provide researchers the power to collect data from a distance, without postage, using the Internet

(11) These applications can present questionnaire data in graphically desirable formats, depending on the price and functionality of the software, to subjects delivered via e-mail, Web sites, blogs, and even social networking sites such as Facebook or Twitter if desirable

(12) Social media mechanisms such as blogs and tweets are often providing sources of data analyses, albeit questionably scientific, that have sometimes been harnessed to extract meaning for researchers

(13) Web surveys, although often criticized for yielding poorer response rates than traditional mail are becoming increasingly popular for their cost and logistical benefits

(14) The data from the Internet can be downloaded for analysis and several applications provide instant summary statistics that can be monitored over the data collection period

(15) Several of these programs are available for free with limited use; others yield advanced products that can be incorporated into the research, giving mobility (e.g., smartphones) and flexibility (e.g., scanning or online entry) to the data capture procedures

(16) Several of these applications include:

  (1) Survey Monkey
  (2) E-Surveys Pro
  (3) Survey System
  (4) Qualtrics
  (5) SNAP Survey software

(17) Many of these products continue to enhance functionality and delivery modes as well as integration with statistical analyses programs and qualitative narrative exportability

Teaching Tip

An example of screen flexibility and scanning output in SNAP is shown in Figure 2.

(18) Several special applications have been used in nursing research that can facilitate large group data capture

(19) Group use applications in specially designed facilities have been developed to engage an audience in simultaneous activity, recording their impressions through electronic keypads located proximal to the users, and capturing that information for display or later analysis

(20) One type of application, Expert Choice 11.5 uses the analytic hierarchy process (AHP), a mathematical technique, with handheld keypad technology to elicit group responses and automatically score, analyze, prioritize, and present information back to the group graphically

(21) AHP has been used as the multiple criteria decision making analysis technique in nursing research studies, and the Expert Choice software allows for group data entry

(22) This kind of groupware for collaborative decision making can supplement data collection from a focus group to add a quantitative component to the subjective question as it elicits and captures opinion via pairwise comparisons

(23) Software packages also exist that can be integrated with the researcher's scanner to optically scan a specially designed questionnaire and produce the subjects' responses in a database ready for analysis

(24) OmniPage 18 is a top rated optical character recognition (OCR) program that converts a scanned page into plain text

(25) Programs such as SNAP Survey software and Remark Office OMR 8 can facilitate scanning large numbers of questionnaires with speed and accuracy

(26) These products, enhanced even more with Web-based products such as Remark Web Survey, increase the accuracy of data entry with very low risk of errors, thereby improving the efficiency of the data capture, collection, and entry processes

c. ***Physiologic data***

(1) The collection of patient physiologic parameters has long been used in physiologic research

(2) Some of these parameters can be measured directly from patient devices such as cardiac monitoring of heart rhythm, rate, and fluid or electrolytes and be captured in the patient care records of the hospital systems

Teaching Tip

For example, hospitals have developed mechanisms to use information from intensive care unit (ICU) data to calculate benchmarks for mortality and resource use.

(3) Now that many measurements taken from various types of imaging (e.g., neurologic, cardiovascular, and cellular) have become digitized, they can also be entered directly from the patient into computer programs for analysis

(4) Each of these applications is unique to the measures, such as systems to capture cardiac functioning and/or pulmonary capacity, devices that can relay contractions, or monitors that pick up electronic signals remotely

(5) Numerous measurements of intensity, amplitude, patterns, and shapes can be characterized by computer programs and used in research

Teaching Tip

For example, the APACHE system in its multiple versions has been tested in benchmarking hospital mortality and outcomes from captured physiologic data in several groups of patients in the ICU.

(6) Each of these measurement systems have evolved with the unfolding of research specific to their questions, and within each community of scholars, issues about the functionality, accuracy, and reliability of electronic data extracted from these physiologic devices are debated

(7) Along with the proliferation of clinical diagnostic measurement systems, there has been a rapid expansion of unique computer applications that have emerged for the data analysis aspects of these clinical systems, physiologic and record sources

(8) Millions of gigabytes of data are stored in machines that can be tapped for multiple studies on the existing data

(9) Data mining is a powerful tool in the knowledge discovery process that can now be done with a number of commercial and open-source software packages

- **(10)** Data mining and the evolving "big data" initiatives to make patient care data available introduces new ways to manipulate existing information systems
- **(11)** With increased attention to CER, several government and private organizations are encouraging researchers to hone the techniques to extract valid and reliable information from these large data sets
- **(12)** Data mining is a mechanism of exploration and analysis of large quantities of data in order to discover meaningful patterns and rules, applied to large physiologic data sets as well as clinical sources of data
- **(13)** The nature of the data and the research question determine the tool selection (i.e., data-mining algorithm or technique)
- **(14)** Tools and consultants exist to help researchers unfamiliar with data mining algorithms to use data mining for analysis, prediction, and reporting purposes
- **(15)** Many of the first commercial applications of data mining were in customer profiling and marketing analyses
- **(16)** Today, many special technologies can be applied, for example, to predict physiologic phenomena such as genetic patterns in tumors that might respond to therapy based on classification of primary tumor gene expression or tissue rejection post-heart transplantation from blood samples and biopsies
- **(17)** The National Institutes of Health (NIH) is undertaking several initiatives to address the challenges and opportunities associated with big data
- **(18)** As one component of the NIH-wide strategy, the Common Fund in cooperation with all NIH Institutes and Centers is supporting the Big Data to Knowledge (BD2K) initiative, which aims to facilitate broad use of biomedical big data, develop and disseminate analysis methods and software, enhance training for disciplines relevant for large-scale data analysis, and establish centers of excellence for biomedical big data

d. ***Unique nursing care data in research***

- **(1)** Scientists and technologists from a variety of disciplines are working hard to identify the domain of data and information that is transferable across situations, sites, or circumstances that can be captured electronically for a wide array of analyses to learn how the health system impacts the patients it serves
- **(2)** The American Nurses Association (ANA) has supported the need to standardize nursing care terms for computer-based patient care systems
- **(3)** The clinical and economic importance of structured recording to represent nursing care was recognized by the acceptance of the nursing minimum data set (NMDS)
- **(4)** The ANA has accepted seven systems of terminology for the description of nursing practice
  - **(1)** The North American Nursing Diagnosis Association (NANDA) taxonomy of nursing diagnosis
  - **(2)** Georgetown Home Healthcare Classification (renamed Clinical Care Classification [CCC] System)
  - **(3)** Nursing Interventions Classification
  - **(4)** Nursing Outcomes Classification
  - **(5)** Patient care data set
  - **(6)** Omaha Home Healthcare
  - **(7)** The International Classification of Nursing Practice
- **(5)** The Clinical Care Classification System nursing terminology has been accepted by the US Department of Health and Human Services (HHS) as a named standard within the Healthcare Information Technology Standards Panel (HITSP) Interoperability Specification for Electronic Health Records, Biosurveillance and Consumer Empowerment as presented to a meeting of the American Health Information Community (AHIC), a federal advisory group on health IT
- **(6)** Although none of the above has emerged as a single standard, national efforts and collaborative efforts with the International Classification of Nursing Practice (ICNP) from the International Council of Nursing (ICN) are underway to "harmonize" the data elements in the NMDS and SNOMED CT (Systematized Nomenclature of Medicine Clinical Terms)
- **(7)** With a structured coding system to record patient care problems that are amenable to nursing actions, the actual nursing actions implemented in the care of patients, and the evaluation of the effectiveness of these actions, researchers can analyze large nursing data
- **(8)** Outcomes research and quality indicators extracted from health information systems (HIS) have become the data end-points that can justify healthcare services
- **(9)** The American Recovery and Reinvestment Act (ARRA) of 2009 called for increased development, certification, and wide-range "meaningful use" of EHRs across healthcare
- **(10)** The federal government has incentivized development of cross-platform compatibility and collaboration
- **(11)** Research on outcomes of care is one of the centerpieces of this massive policy that has begun to show an impact on integrated information technologies in healthcare that can transform practice
- **(12)** Nursing research on nursing practice captured from standardized terminology will be essential to document outcomes of nursing care

2. Data coding

a. In most quantitative studies, the data for the variables of interest are collected in a numerical form

- **(1)** These numerical values are entered into designated fields in the process of coding
- **(2)** Coding may be inherent in software programs for the physiologic data and many of the electronic surveys
- **(3)** The coding may be generated by a computer program from measurements directly obtained through imaging or physiologic monitoring, or entered into a computer by a patient or researcher from a printout or a questionnaire or survey into a database program

(4) Most statistical programs contain data editors that permit the entry of data by a researcher as part of the statistical application

(5) In such a situation, fields are designated and numerical values can also be entered into the appropriate fields without the use of an extra program

(6) For mechanisms that translate and transfer source data to prepare it for analysis, generic programs such as Microsoft Excel serve multiple needs

(7) In addition to allowing simple transfers of data from source to a statistical analysis package, Excel has its own powerful, but simple, analysis capabilities and exceptionally easy to use graphic translators that can turn statistics into visual graphs and charts

(8) Coding data is a precise operation that needs careful consideration and presents the researcher with challenges that warrant technical or cognitive applications

(9) Coding data is a combination of cognitive decisions and mechanical clerical recording of responses in a numerical form with numerous places for error to occur

(10) There are several ways of reviewing and "cleaning" the data prior to analysis

(11) Some computer programs allow for the same data to be entered twice called double-data entry or two-pass verification

(12) This is done preferably by different people to check for errors, with the premise that if the double entry does not match, one entry is wrong

(13) One also must check for missing data and take them into consideration in the coding and analyses

(14) New versions of advanced statistical software help in these activities

(15) Reviewing data for values outside of those allowable is another way of examining the data for errors

(16) It can best be done by examining the multiple printouts produced by the statistical software packages or procedures invoked in the statistical application and by carefully perusing for outliers or artifacts

(17) Another type of data coding can be described in the example of the process of translating data from documentation of patient care using coding strategies

(18) Current research on coding nursing data using standardized nursing terminology from standardized codes is evident in several research studies in the literature

Teaching Tip

For example, using precisely coded data from a standardized terminology can produce data that can be aggregated and statistically analyzed into meaningful information.

(19) In several studies by Saba and Taylor, Moss and Saba, and Saba and Arnold, researchers have discussed mechanisms of aggregating nursing action types, for example, assess, perform, teach, or manage, into aggregated information on the amount of time or effort a nurse spends in a day and concomitant costs associated

(20) Another application of coding data occurs with mapping concept codes from one terminology to another

Teaching Tip

For example, coding data for a nursing diagnosis can be mapped between terminologies for interoperability, for example, mapping the CCC Nursing Diagnosis concept of pain to a SNOMED CT code for the same concept (CCC Acute Pain—Q63.1 mapped to SNOMED Acute Pain—274663001).

(21) These translations of codes support the ever-evolving interoperable computer systems that produce nursing data reports which can cross platforms or institutions

3. Data analysis

a. Data analysis in a quantitative study combines a variety of techniques that apply statistical procedures with the researcher's cognitive organization of research questions, results, and visual or textual information, translated into tables, charts, and graphs to make the data meaningful

(1) It translates the numeric and conceptual elements of the inquiry into meaningful representations of information

(2) In general, the statistical analyses are ordered by the conceptual arrangement of hypotheses, variables, measurements, and relationships, and ultimately answer the research questions

(3) There are many ways to consider data analysis

(4) The presentation below is organized around the broad types of research of interest in nursing and general research goals or questions

(5) The researcher may use different types of analyses depending on the goal of research

(6) These goals may require different statistical examinations: descriptive and/or exploratory analyses, hypothesis testing, estimation of confidence intervals, model building through multivariate analysis, and structural equation model building

(7) Various types of nursing research may contain a number of these goals

Teaching Tip

For example, to test an intervention using an experimental or quasi-experimental design, one may first perform descriptive or exploratory analyses followed by tests of the hypotheses.

(8) Quality improvement, patient outcome, and survival analysis studies may likewise contain a number of different types of analyses depending on the specific research questions

(9) In general, the statistical analysis steps of the research process rely heavily on the functions specific to a variety of statistical software applications

(10) Two of the most popular programs in use today are the IBM SPSS Statistics 22 (formerly Statistical Package for Social Sciences) and Statistical Analysis Services

(SAS Version 9.2), however a variety of other packages and programs exist, such as STATA or Minitab 17 unique to particular scientific disciplines

(11) Which package one selects depends on the user's personal preference, particular strengths, and limits of the applications including number of variables, options for analyses, and ease of use

(12) These packages have given the user the power to manipulate large data sets with relative ease and test out statistical combinations that have exponentially improved the analyses possible in a fraction of time that it once took

(13) The different types of analyses required by the goals of the research will be addressed further

(14) This description will be followed by examples of types of nursing research that incorporate some of these types of analyses

b. ***Descriptive and exploratory analysis***

(1) The researcher may first explore the data means, modes, distribution pattern, and standard deviations, and examine graphic representations such as scatter plots or bar graphs

(2) Tests of association or significant differences may be explored through chi-squares, correlations, and various univariate, bivariate, and trivariate analyses, and an examination of quartiles

(3) During this analysis process, the researcher may recode or transform data by mathematically multiplying or dividing scores by certain log or factor values

(4) Combining several existing variables can also create new variables

(5) These transformations or "re-expressions" or "dummy-coding" allow the researcher to analyze the data in appropriate and interpretable scales

(6) The researcher can then easily identify patterns with respect to variables as well as groups of study subjects of interest

(7) Both commercial statistical packages provide the ability to calculate these tests and graphically display the results in a variety of ways

(8) IBM SPSS Statistics 22 (IBM SPSS, 2010) provides the user with a broad range of capabilities for the entire analytical process

(9) SPSS is a modular, tightly integrated, and full-featured software comprised of the SPSS base and a range of add-on modules

(10) With SPSS, the researcher can generate decision-making information quickly using a variety of powerful statistics, understand and effectively present the results with high-quality tabular and graphical output, and share the results with others using various reporting methods, including secure Web publishing

(11) SAS 9.2 provides the researcher with tools that can help code data in a reliable framework, extract data for quality assurance, exploration, or analysis, perform descriptive and inferential data analyses, maintain databases to track, and report on administrative activities like data collection, subject enrollment or grant payments, and deliver content for reports in the appropriate format

(12) SAS allows for creating unique programming within the variable manipulations and is often the format for large publicly available data sets for secondary analysis

(13) Stata 13 and SYSTAT 13 are also fully integrated statistical packages with full database management capabilities and a range of sophisticated statistical tests particularly useful for epidemiologists and physical scientists

(14) All of these statistical packages have evolved to provide an integrated collection of tools that assist in aspects of research study management—from planning to dissemination—in addition to the reputable statistical analyses and data manipulation capabilities that they have provided for many years

(15) As part of exploratory analysis, simple, binary, and multiple regression analyses can be used to examine the relationships between selected variables and a dependent measure of interest

(16) Certain models can be developed to determine which collection of variables provides the best prediction of the dependent measure

(17) Printouts of correlation matrices, extensive internal tests of data assumptions on the sample, and regression analysis tables provide the researcher with condensed, readable statistical information about the relationships in question

c. ***Hypothesis testing or confirmatory analyses***

(1) Hypothesis testing or confirmatory analyses are based on an interest in relationships and describing what would occur if a hypothesis was true

(2) The analysis of data allows us to compare the actual outcomes with the hypothesized outcomes

(3) Inherent in hypothesis testing is the probability (P value) of an event occurring given a certain relationship

(4) These are conditional relationships based on the variables selected for study, and the typical mathematical tables and software for determining P values are accurate only insofar as the assumptions of the test are met

(5) Certain statistical concepts such as statistical power, type II error, selecting alpha values to balance type II errors, and sampling distribution are decisions that the researcher must make regardless of the type of computer software

(6) These concepts are covered in greater detail in research methodology courses and are outside the scope of the present discussion

Teaching Tip

An example, Power and Precision (Version 2), is a computer program for statistical power analysis and confidence intervals.

d. ***Model building***

(1) An application used for a confirmatory hypothesis testing approach to multivariate analysis is structural equation modeling (SEM)

(2) Byrne describes this procedure as consisting of two aspects
    i. The causal processes under study are represented by a series of structural (i.e., regression) equations
    ii. These structural relations can be modeled pictorially to enable a clearer conceptualization of the theory under study
(3) The model can be tested statistically in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data
(4) If goodness of fit is adequate, the model argues for the plausibility of postulated relationships among variables
(5) Most researchers may wish to consult a statistician to discuss the underlying assumptions of the data and plans for testing the model
(6) Traditionally, different types of modeling programs, such as LISREL or EQS are commercially available
(7) The researcher will identify latent (unobservable) variables of interest (e.g., emotions) and link them to those that are observable (direct measurement) and plan with the statistician to specify and examine the impact of one latent construct on another in the modeling of causal direction
(8) IBM SPSS 22 (IBM SPSS Software Inc.) offers Amos 22, a powerful SEM and path analysis add-on to create more realistic models than if using standard multivariate methods or regression alone
(9) Amos is a program for visual SEM and path analysis
(10) User-friendly features, such as drawing tools, configurable toolbars, and drag-and-drop capabilities, help the researcher build structural equation models
(11) After fitting the model, the Amos path diagram shows the strength of the relationship between variables
(12) Amos builds models that realistically reflect complex relationships because any variable, whether observed (such as survey data) or latent (such as satisfaction or loyalty) can be used to predict any other variable

e. ***Meta-analysis***
(1) Meta-analysis is a technique that allows researchers to combine data across studies to achieve more focused estimates of population parameters and examine the effects of a phenomenon or intervention across multiple studies
(2) It uses the effect size as a common metric of study effectiveness and deals with the statistical problems inherent in using individual significance tests in a number of different studies
(3) It weights study outcomes in proportion to their sample size and focuses on the size of the outcomes rather than on whether they are significant
(4) Although the computations can be done with the aid of a reliable commercial statistical package such as Meta-Analysis, the researcher needs to consider the following specific issues in performing the meta-analysis
    i. Justify which studies are comparable and which are not
    ii. Rely on knowledge of the substantive area to identify relevant study characteristics
    iii. Evaluate and account for differences in study quality
    iv. Assess the generalizability of the results from fields with little empirical data
(5) Each of these issues must be addressed with a critical review prior to performing the meta-analysis
(6) Meta-analysis offers a way to examine results of a number of quantitative research that meet meta-analysis researchers' criteria
(7) Meta-analysis overcomes problems encountered in studies using different sample sizes and instruments
(8) The software application Meta-Analysis provides the user with a variety of tools to examine these studies
(9) It can create a database of studies, import the abstracts or the full text of the original papers, or enter the researcher's own notes
(10) The meta-analysis is displayed using a schematic that may be modified extensively, as the user can specify which variables to display and in what sequence
(11) The studies can be sorted by any variable, including effect size, the year of publication, the weight assigned to the study, the sample size, or any user-defined variables to facilitate the critical review done by the researcher

Teaching Tip
See Figure 47.3.

f. ***Graphical data display and analysis***
(1) There are occasions when data need to be displayed graphically as part of the analysis and interpretation of the information or for more fundamental communication of the results of computations and analyses
(2) Visualization software is becoming even more useful as the science of visualization in combination with new considerations of large data from the "Fourth Paradigm" unfolds
(3) These ideas begin with the premise that meaningful interpretation of data intensive discoveries need visualizations that facilitate understanding and unfolding of new patterns
(4) Nurses are currently discovering new ways to present information in meaningful ways through these visualization techniques
(5) Most statistical packages including SPSS, SAS, and STATA, and even spreadsheets such as Excel, provide the user with tools for simple to complex graphical translations of numeric information, thus allowing the researcher to display, store, and communicate aggregated data in meaningful ways
(6) Special tools for spatial representations exist, such as mapping and geographic displays, so that the researcher can visualize and interpret patterns inherent in the data
(7) Geographic information system (GIS) technology is evolving beyond the traditional GIS community and becoming an integral part of the information infrastructure of visualization tools for researchers

Teaching Tip
For example, GIS can assist an epidemiologist with mapping data collected on disease outbreaks or help a health services researcher graphically communicate areas of nursing shortages.

(8) GIS technology illustrates relationships, connections, and patterns that are not necessarily obvious in any one data set, enabling the researcher to see overall relevant factors

(9) ArcGIS 10 system is a GIS for management, analysis, and display of geographic knowledge, which is represented using a series of information sets

(10) The information sets include maps and globes with 3-dimensional capabilities to describe networks, topologies, terrains, surveys, and attributes

(11) In summary, the major emphasis of this section has provided a brief discussion about the range of traditions, statistical considerations, and computer applications that aid the researcher in quantitative data analysis

(12) As computers have continued to integrate data management functions with traditional statistical computational power, the researchers have been able to develop more extensive and sophisticated projects with data collected

(13) Gone are the days of the calculator or punch cards, as the computing power now sits on the researchers' desktops or laptops, with the speed and functionality at their fingertips

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Qualitative Approach

1. Data capture and data collection
   a. The qualitative approach focuses on activities in the steps of the research process that differ greatly from the quantitative methods in fundamental sources of data, collection techniques, coding, analysis, and interpretation

      (1) Thus, the computer becomes a different kind of tool for the researcher in most aspects of the research beginning with the capture and recording of narrative or textual data

      (2) In terms of qualitative research requiring narrative content analysis, the computer can be used to record the observations, narrative statements of subjects, and memos of the researcher in initial word processing applications for future coding

      (3) Software applications that aid researchers in transcription tasks include text scanners, such as OmniPage 18

      (4) Other devices include vocal recorders or speech recognition software such as consumer priced Dragon Naturally Speaking 12, where the researcher can input the information into text documents by speaking into a microphone without typing

      (5) New digital recorders are also on the market that use sophisticated and higher cost voice recognition software

      (6) From these technologies, researchers or transcriptionists can easily manipulate the recording and type the data verbatim

      (7) Even iPhones and smartphones have high-quality recording applications that aid the qualitative research capture narrative statements

      (8) These narrative statements, like the quantitative surveys, can be either programmed for use in other applications or subjects' responses can be entered directly into the computer

   b. ***Qualitative data collection***

      (1) Audiotaping is often used for interviews in qualitative studies, whereby the content is transcribed into a word processing program for analysis

      (2) The narrative statements are stored for subsequent coding and sorting according to one's theoretical framework

      (3) Through analysis, categories from the data emerge as interpreted by the researcher

      (4) It is important to point out that for both quantitative and qualitative data, the computer application program is only a mechanical, clerical tool to aid the researcher in manipulating the data

      (5) Using the Internet for indirect and direct data collection in qualitative studies can also provide a vehicle for data analysis that yields a quantitative component as well as the qualitative analysis

      (6) Computers are not only able to record the subject's responses to the questions, but can record the number of minutes the subject was online and the number of times they logged in

      (7) Many new online technologies are providing functionality for qualitative studies: for example, Audacity, an open source free audio recording package can edit captured voice and export audio data to be analyzed; conversely, online survey packages such as SurveyMonkey, can now export participants' free text data into qualitative software packages

2. **Data coding and data analysis**
   a. Historically, qualitative researchers have relied on narrative notes, often first recorded as audio and later transcribed by a typist

      (1) Coding qualitative text data was a time-consuming task, often involving thousands of pages of typewritten notes and the use of scissors and tape for the development of coding and categories

      (2) With the advent of computer packages, the mechanical aspects of the coding and sorting have been reduced

      (3) The researcher must decide on which text may be of interest and can use a word processing program to search for words, phrases, or other markers within a text file

      (4) However, this process is cumbersome and time-consuming, with limited ways to aggregate text into meaningful combinations for identifying themes from the narrative

 (5) Some specific software packages developed for qualitative data analysis (QDA) interface directly with the most popular word processing software packages
 (6) The early application program Ethnograph was one of the first packages developed specifically for the purpose of managing some of the mechanical tasks of QDA
 (7) Ethnography 6.0 gave users, a project management interface with functions to code, edit, and search data
 (8) The older nonnumerical unstructured data indexing, searching, and theorizing (NUD-IST) software was another qualitative package commonly used, now absorbed in other QDA products
 (9) This program assisted the researcher to establish an index of data codes and seek relationships among the coding categories
 (10) The ease with which researchers can code and recode large amounts of data with the aid of computerized programs encourages the researcher to experiment with different ways of thinking about data and recategorizing them
 (11) Retrieval of categories or elements of data is facilitated by computer storage
 (12) Newer technologies have evolved from Ethnograph and NUD-IST with improved user interfaces, including the latest versions of NVivo 10 (QSR, 2012), MAXQDA 11, and ATLAS.ti 7
 (13) Qualitative research, like quantitative research, is not a single entity, but a set of related yet individual traditions, aims, and methods
 (14) Some individual traditions within qualitative research are ethnography, grounded theory, phenomenology, and hermeneutics
 (15) The distinguishing feature of qualitative research is that the goal is to understand the qualities or essence of phenomena and/or focus on the meaning of these events to the participants or respondents in the study
 (16) The forms of data are usually the words of the respondents or informants rather than numbers
 (17) Computerization is especially helpful to the researcher in handling large amounts of data
 (18) However, it must be stressed that the computer applications aid the analysis as a management tool rather than an analytical one
 (19) Synthesis of the data is still the interpretive work of the researcher

b. ***Computer application programs***
 (1) A number of general-purpose or specific software packages can be used in qualitative analysis
  i. One package is a free text retrieval program such as that available in a word processing program
  ii. Another is any number of standard database management or indexing programs
  iii. Third is a program specifically developed for the purpose of qualitative analysis

c. ***General purpose software***
 (1) Word processing programs offer a number of features useful to the qualitative researcher in the early stages of analysis
 (2) The ability to search for certain key words allows the researcher to tag the categories of interest
 (3) In addition, such features as cut and paste; linking texts; insertion of pictures, tables, and charts; and the inclusion of video and audio data enhance the application
 (4) Add-on applications specific to integrating multiple elements help the researcher organize a range of data and materials for analysis
 (5) These files can then be incorporated into more sophisticated programs
 (6) A comprehensive program is ATLAS.ti (Version 7.0) a powerful workbench for the qualitative analysis of large bodies of textual, graphical, audio, and video data
 (7) It offers a variety of tools for accomplishing the tasks associated with any systematic approach to “soft” data, such as material that cannot be analyzed by formal and statistical approaches in meaningful ways

d. ***Special purpose software***
 (1) Several software products have evolved and improved for the specific purpose of analyzing qualitative data
 (2) Ethnograph from Qualis Research is one such older program, which is used after the data have been entered with a word processing program and converted to an ASCII file
 (3) Each file can be designated by its context and identifying features using markers provided by the computer program
 (4) The researcher can have the program produce a file that numbers each line of the narrative data
 (5) From this line file, the researcher can begin to assign each line or paragraph a category
 (6) The researcher keeps track of the category definitions and is alert to dimensions that emerge
 (7) Recoding can be done to provide for inductive thinking and iterative comparisons
 (8) Through the use of a search command, the computer program can be made to search for data segments by categories throughout the typed document
 (9) NVivo 10 and XSight from QSR provide a new generation of software tools with multiple advantages for researchers
 (10) Because qualitative research takes many forms, these two applications can be selected based on the user’s specific methodologic goals, the nature and scale of the study, and the computer equipment
 (11) While NVivo 10 supports fluid, rich data, detailed text analysis, and theory building, it also can manage documents, audio and video files as categories, attributes or nodes in visual displays that show the structure and properties of the document

Teaching Tip
Refer to Figure 47.4.

- **(12)** The latest version of NVivo 10 also allows researchers to import exported data from other applications such as the online survey tool, Survey Monkey, as well as bibliographic management programs, Facebook and Twitter
- **(13)** New analysis tools provide the research ways to cluster, map and visualize text and images in meaningful ways to aid the interpretive process in the qualitative analysis

f. ***Conceptual network systems***

- **(1)** A system known as concept diagrams, semantic nets, or conceptual networks is one in which information is represented in a graphic manner
- **(2)** The objects in one's conceptual system (e.g., age and experiences) are coded and represented by a box diagram (node)
- **(3)** The objects are linked (by arcs) to other objects to show relationships
- **(4)** Like rule-based systems, semantic nets have been widely used in artificial intelligence work
- **(5)** In order to view the relationships of an object in the system, the researcher examines the node in the graph and follows the arcs to and from it
- **(6)** Semantic network applications may be useful in model building and providing a pictorial overview
- **(7)** Decision Explorer offers the user a powerful set of mapping tools to aid in the decision-making process for audience response activities
- **(8)** Ideas can be mapped and the resulting cognitive map can be further analyzed

Teaching Tip
Refer to Figure 47.5.

- **(9)** The software has many practical uses, such as gathering and structuring interview data and as an aid in the strategy formulation process
- **(10)** The software is primarily described as being a recording and facilitation tool for the elicitation of ideas, as well as a tool to structure and communicate qualitative data
- **(11)** It allows the user to gather and analyze qualitative data and thus make sense of many pieces of qualitative data in order to achieve a coherent picture of a given issue or problem

g. ***Data analysis for qualitative data***

- **(1)** Qualitative data analyses often occur on an ongoing basis with data collection in a reflexive and iterative fashion
- **(2)** There is no clear demarcation of when data collection should end and analysis should begin
- **(3)** The process of obtaining observations, interviews, and other data over a period of time results in a vast body of narrative that may include hundreds or thousands of pages of field notes and researcher memos
- **(4)** Although computer applications can aid considerably in organizing and sorting this mass of data, the theoretical and analytical aspects of decision making about concepts and themes must be made by the researcher
- **(5)** Researchers can only use the tools to help in creating composites described by methodologists in coding levels and categorical clusters

Teaching Tip
For example, some of the tasks the computer can facilitate in data analysis using grounded theory (one approach to qualitative research) are as follows.

- **(6)** Once a researcher has determined which parts of the interviews and observations can be tagged as categories, certain properties or dimensions can be determined and coded up through levels
- **(7)** The researcher may engage in "constant comparison," comparing the meanings of all incidents that have been similarly categorized
- **(8)** This process should continue until the researcher determines that the categories are internally consistent, fit with the data, and are saturated. Saturation is achieved when the researcher can find no more properties for a category and new data are redundant with the old
- **(9)** Classic qualitative methods experts Strauss and Corbin suggested that in the later stages of research, the researcher may engage in axial coding
- **(10)** In this stage, the researcher elaborates and explains key categories, considering the conditions under which the event occurs, the processes that take place, and possible consequences
- **(11)** Another well-known methodologist, Glaser indicated that the researcher may engage in theoretical sampling, which is a deliberate search for episodes in incidents that enlarge the variances of properties and place boundaries around categories
- **(12)** Using software, these cognitive processes are applied by the researcher in data analysis of narrative interviews, field notes, and supplementary data

h. ***Uses and caution***

- **(1)** Software programs exist for qualitative research that save researcher time doing file management, reducing the manual labor of cutting, pasting, sorting, and manual filing
- **(2)** They may also encourage the researcher to examine the data from different perspectives, recoding and reorganizing the data in different frameworks
- **(3)** However, one must be mindful that qualitative analysis is a cognitive process, not a mechanical one
- **(4)** The essence of qualitative research is the meaning and interpretation of the data within context
- **(5)** The ability of software enhancements to generate quasi-frequency distributions and cross-tabulations tend to further increase the investigator's confidence in believing such findings and relationships, when in fact these may be an artifact of the way in which the data are manipulated
- **(6)** While computer programs facilitate coding, organization of data, and preparation of the data for interpretation, they cannot replace the thinking and decision making that is at the heart of qualitative analysis

(7) As in all research, the burden of analysis and interpretation rests with the researchers

3. **Dissemination of results**
   a. While dissemination of results continues to occur by traditional means such as presentations at professional meetings and publication in journals and monographs, online reporting is becoming increasingly common
      (1) Some Web sites frequented by nurses are peer-reviewed journals such as *Online Journal of Nursing Informatics* and selected nursing articles on various Web sites such as that of the ANA
      (2) Nursing forums sponsored by various professional nursing organizations (e.g., *American Journal of Nursing*, Sigma Theta Tau, and National League for Nursing) often allow participants to chat online with presenters or authors of certain articles on designated dates during scheduled times
      (3) Nearly all organizations have their own Web sites

Teaching Tip
Some examples are the Alzheimer's Disease Education and Referral Center, American Heart Association, American Medical Informatics Association, and RAND Corporation.

      (4) The Cochran Collection has numerous centers all over the world through the Cochrane Collaborative
      (5) As with all publications, online as well as hardcopy, the information accessed must be evaluated by the users regarding appropriateness for the purpose for which it was retrieved
      (6) Reports to most government and some nongovernment agencies require the researcher to submit a converted document online
      (7) Grant proposals submitted to the federal government currently require online submission with conversion to PDF
      (8) NIH applicants are directed to a page with downloadable programs to convert the documents before submitting them
      (9) In fact, there is a trend for all manuscripts to be submitted online for print, online, or both
      (10) Online journals continue to grow
      (11) In addition, there has been a rise in the number of open access journals that give researchers more options for dissemination
      (12) Online journals have been discussed in the nursing and academic community with mixed reception; while it allows the researcher-consumer of articles the ability to search wider publicly available science, other stakeholders in the publishing and academic worlds have been concerned on the ramifications of this disruptive innovation
      (13) Regardless of the method of submission and medium for publication, the published article may be incorporated into one or several online bibliographic retrieval systems
      (14) The researcher is not finished until the work is disseminated
      (15) This chapter has summarized the processes of quantitative and qualitative research and described select computerized tools that can assist the researcher in proposal preparation, data collection, data coding, data analysis, and dissemination for both types of research
      (16) The following section highlights examples for three categories of research on computer use and nursing informatics in
         i. Electronic data, such as data mining large electronic data sets and electronic nursing documentation
         ii. Web-based interventions
         iii. Specialized computer applications in clinical practice
      (17) The examples include both quantitative and qualitative studies in which the nurse researchers inevitably used a variety of software tools in the proposal development, data collection, measurement of variables, analysis, and dissemination activities

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Examples of Research Studies

1. Overview
   a. Computers are inextricably tied to the process of conducting research, but there are also good examples of research on computer use in the nursing literature
      (1) Several of the following examples also describe computerized processes for conducting quantitative and qualitative research approaches
      (2) These examples provide focus on nursing research related to computer use and informatics as well as using computers in the process of doing the research
2. **Clinical interventions with computers**
   a. Over the past 10 years, Internet applications have been introduced into practice and tested in a variety of clinical trials aimed to improve conditions for patients
      (1) For example, a team of researchers developed the Personal Patient Profile-Prostate (P3P), a Web-decision support system for men newly diagnosed with prostate cancer that assesses patients' preferences prior to clinic visit and gives providers and patients information to aid decision making among choices of treatment
      (2) The studies showed that decision support was feasible with the technology support
      (3) Decision regret was significantly influenced by personal characteristics and posttreatment symptoms, although the P3P was not itself significant on the outcomes measured in the study
      (4) In another Web-based intervention, caregivers were randomly assigned to one of two types of online

support groups and compared to non-active participants on their depressive symptoms, caregiver burden, and quality of life

(5) In this study, both types of online support groups reduced depressive symptoms and improved quality of life over non-active participants

3. Technology, electronic data, and electronic documentation research

a. There are several different studies that highlight using electronic data and EHRs in data mining or care documentation

b. ***Secondary analysis of large data sets***

(1) Large public data sets are becoming more available to nurse researchers to explore health-related questions

(2) The sites provide tutorials and assistance, making them more accessible for secondary analyses

Teaching Tip
For example, the Agency for Healthcare Research and Quality (AHRQ) provides health services investigators with the tools and data sources for a variety of health-related systems.

(3) One data source is the Medical Expenditures Panel (MEPS) database, a multiyear set of large-scale surveys of families and individuals, their medical providers, and employers across the United States

(4) MEPS is the most complete source of data on the cost and use of healthcare and health insurance coverage

(5) Another collection used by a variety of nurse researchers is the HCUP data from AHRQ

(6) HCUP databases bring together the data collection efforts of state data organizations, hospital associations, private data organizations, and the federal government to create a national information resource of encounter-level healthcare data

(7) It includes the largest collection of longitudinal hospital care data that enables research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to healthcare programs, and outcomes of treatments at the national, state, and local market levels

(8) The EHRs today are frequently providing source data for studies

(9) These hospital systems have been used in the literature

Teaching Tip
For example, EHR records were used in a study done by Almasalha and colleagues. They examined 596 episodes of care that included pain as a problem on a patient's care plan using statistical and data mining tools to identify hidden patterns in the information on end-of-life (EOL) hospitalized patients. Findings suggested new understanding about patient care, for example, EOL patients with hospital stays less than three days were less likely to meet the pain relief goals than those with longer hospital stays.

(10) Westra and colleagues studied urinary and bowel incontinence for home health patients using EHR data to predict improvements

(11) In these cases, the EHR served as the data source

(12) Figar and colleagues used a private HIS clinical documentation system to study whether captured data could predict influenza outbreaks

(13) They used a local interface terminology server, which provides support through data auto-coding of clinical records and analyzed specific data sets to compare the burden of influenza in epidemiological weeks identified among 150,000 Health Maintenance Organization members in Argentina

(14) The HIS detected the outbreak two weeks before the health department gave a national alert and was useful in assessing morbidity and mortality during the 2009 influenza epidemic H1N1 outbreak

c. ***Computerized documentation of nursing care plans***

(1) Moss and Saba studied the utility of costing out nursing care with the CCC terminology on five most commonly executed interventions

(2) Using an observation study of nurses performing routine care on an acute-care unit, investigators collected data with a specialized data collection program entered directly into the PC database

(3) A total of 251 interventions were observed, coded, and analyzed

(4) From the analysis of time spent on each entered intervention, researchers could describe the four action types by average cost and percent of activity

(5) The study demonstrated the feasibility of valuating the nursing care given to patients based on the standardized CCC terminology

(6) In a randomized trial on electronic documentation of nursing care plans, Feeg, Saba, and Feeg tested the quality of nursing student care planning on a bedside PC using a standardized nursing terminology in a specially designed Microsoft Access database program (Clinical Care Classification System) compared with an open-text format type-in application with the same terminology

(7) Students were randomly assigned to one of the two versions of electronic nursing documentation formats and interviewed two simulated patients who served for all of the participants

(8) The simulated patients were interviewed about their symptoms: one presented with congestive heart failure, the other with pneumonia

(9) Students were instructed to document the care immediately following the interview on a laptop stationed at the patient's bedside

(10) Measures were developed to assess the quality of the care plans and the participants' evaluation of using the system

(11) Data were analyzed, revealing a statistically significant difference ($p = .05$) for the Microsoft Access care plans completed by students and a statistically significant difference in the students' reports on using the system ($p = .025$)

- **(12)** In a follow-up field study, the system was implemented on 49 students over three semesters who documented care for each patient they were assigned to in their clinical rotations
- **(13)** Students were assessed on their care plan documentation and they reported usability and satisfaction with the computer-based documentation system
- **(14)** Results continued to show that the coded language and PC care planning method was efficient and effective

d. ***Web-based tools and interventions***

- **(1)** A significant body of research has been conducted on using the Internet as a tool for conducting research, as well as studies on Web-designed interventions for clinical problems
- **(2)** For example, Yen and Bakken tested the usability of a Web-based tool for managing open shifts on nursing units
- **(3)** Using observational and interview approaches, they evaluated a Web communication tool (BidShift) designed to allow managers to announce open work shifts to solicit staff to request their own work shifts
- **(4)** They used specialized software to capture screens and vocal utterances as participants were asked to think aloud as they completed three subtasks associated with the open-shift management process
- **(5)** After task completion, they were asked about the process and their responses were recorded
- **(6)** Their data were managed and coded using Morae, specialized software developed for usability testing
- **(7)** This example of qualitative research reported participants' patterns of use and themes related to their perceptions of usability of the communication tool
- **(8)** In another qualitative study on electronic encounters using Web-based videoconferencing, Nystrom and Ohrling created a series of e-meetings for new fathers of children under one year old to "meet" in parental support groups
- **(9)** The technology allowed both one-on-one and group encounters. The fathers were interviewed using a narrative approach and content analysis was applied to the interview data
- **(10)** The researchers identified three categories from the transcripts
    - **i.** Being unfamiliar and insecure talking about fatherhood
    - **ii.** Sharing experiences and being confirmed
    - **iii.** Being supported and limited by the electronic encounters
- **(11)** Andersen and Ruland studied an Internet-based online patient–nurse communication (OPNC) service to support patients with prostate and breast cancer
- **(12)** Using qualitative content analysis, they examined 276 messages in a tailored Internet support intervention over 15 months
- **(13)** Two main themes emerged
    - **i.** Concerns about physical symptoms and treatment side effects
    - **ii.** Worries and questions about treatment and follow-up
- **(14)** They concluded that the OPNC service can meet patients' needs for advice and information, thus improving the quality of care
- **(15)** In a qualitative study by Lichenstein, McDonough, and Matura, 98 participants who self-identified as caregivers for a person with pulmonary hypertension (PH) engaged in an online discussion board posted by the Pulmonary Hypertension Association over an 18-month period
- **(16)** Clinical variables collected were medications and oxygen use, and years since diagnosis
- **(17)** Thematic analysis yielded four themes: fear and frustration, questions and concerns, someone to listen to, and moving on with life
- **(18)** Results showed that caregivers of people with PH may be ill equipped to care for their loved one because of lack of knowledge or psychological distress
- **(19)** In a review of Web-based cognitive behavioral interventions for chronic pain, researchers conducted a systematic review and meta-analysis to quantify the intervention efficacy for treatment of patients with chronic pain
- **(20)** Using 11 studies from MEDLINE and other data sources, the investigators found that Web-based interventions for chronic pain resulted in small pain reductions in the intervention groups compared with waiting-list control groups

e. ***Specialized computer applications in clinical care***

- **(1)** Computer-based administration of assessment is a reliable means of collecting patient assessment data as demonstrated by the report by Wilkie and colleagues who evaluated the feasibility and acceptability of a pentablet-based software program that assesses patients' cancer-related symptoms, the PAIN*Report*It®
- **(2)** In the study, 131 patients were able to use the computerized tool and reported high acceptability scores
- **(3)** Vawdrey and colleagues pilot tested a tablet computer application for patients to participate in their hospital care
- **(4)** A prototype application was developed for a tablet computer using EHR queries and updates in real time
- **(5)** Patients were invited to participate in the study after consultation between the patient's providers and the investigator, an attending cardiologist
- **(6)** They were given an iPad device and encouraged to use the application
- **(7)** Structured interviews were used to test the patient engagement and the tablet usefulness of having access to patient's own medication and hospital history
- **(8)** Mobile technologies have also proliferated in health-related applications today
- **(9)** For example, systems that support medication management of patients with SMS texting and Web-based interface programs have emerged using simple cell phones and sophisticated smartphones

(10) The MyMediHealth (MMH) is a medication management system that includes a medication scheduler, a medication administration reminder engine, and sends text messages to patient phones

(11) In a review done by Schroeder, a variety of studies used computerized telephone technologies as an assessment tool specifically for the collection of daily, self-reports of HIV-risk behaviors

(12) The review presented advantages of applications of interactive voice response technology (IVR) to HIV-risk behavior research, including feasibility studies, assessment mode comparisons between IVR and alternative self-reporting methods, and unique findings derived from event-level data analyses illuminating risk factors for unprotected intercourse on within-person level

(13) The author concluded that these specialized interactive, computerized voice systems are highly promising tools for various research and healthcare applications that should be considered more frequently for use in HIV-risk populations

(14) Some studies that incorporate remote technologies in special applications have been described in the literature

(15) Mahoney reported on several mixed methods studies that describe innovative monitoring intervention research with older adults and their informal and/or formal caregivers

(16) The studies were conducted in "real-world" homes and focused on improved ways to monitor elders, taking into account the goal of independence and privacy, to alert caregivers on elders' activities, and safety issues

(17) In another collection of case studies, Rantz and colleagues describe instances of technology-enhanced monitoring capabilities, using sensors, alarms, and environmentally embedded devices, that wirelessly communicate with programmed systems for the purpose of detecting potential problems

(18) These and other innovations that connect computer technology with nursing practice have emerged with research to support their functionality, ease of adoption, and efficacy

(19) The range of innovation has been astounding as the technologies have increasingly become less expensive, smaller, wireless, and now interconnected with cloud computing

(20) Nursing research and computers today are inseparable in both areas of using computers for the research and studying the impact of computers on patient care

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- This chapter has reviewed two research paradigms and philosophical orientations—qualitative and quantitative methods—that specify different underlying approaches to research and the use of computers in various stages of the research process
- It also highlighted examples of research on computer use with these quantitative and qualitative approaches
- A variety of computer applications are available via commercialized packages that serve the nurse researcher in conducting research
- With the advancements in applications development and delivered wirelessly and the wide use of smaller devices such as smartphone technologies, the potential for innovation and research on health abounds
- Prompted by large consortia that foster technology innovation such as Health Datapalooza (healthdatapalooza.org), an annual conference for researchers and entrepreneurs, one can expect the emergence of many
- With the federal government emphasis on big data, the enhancements made to aid researchers to tackle existing data sets, and the cloud to house and connect researchers and subjects from distances, one can expect a proliferation of research techniques and acceptable evidence using secondary data
- In addition, research on computer applications and informatics is a growing body of science that will continue to appear in the literature with a renewed purpose of collecting and storing meaningful data for multiple uses
- Carrington and Tiase state "Health information technology (HIT), and more specifically, nursing informatics, is the driving force for the transformation of health care in the United States… Nurses' … role in the use of technology [has evolved]"
- Nursing informatics research has been influential in shaping health
- In a review of literature published in one year, Carrington and Tiase describe topics ranging from EHR, monitoring, and human–computer interaction to bar code administration
- The studies were 31% qualitative, 54% quantitative, and 15% mixed methods
- They conclude that the design, implementation, and evaluation of nursing technologies show promise in nursing efficiencies that affect patient safety and healthcare cost, the two driving forces of policies that shape healthcare
- The contextual influences on nursing research are discussed by Bakken and colleagues
- The nursing informatics research agenda for the next 10 years must expand users of interest to include interdisciplinary researchers; build upon the knowledge gained in genomic and environmental data; guide the reengineering of nursing practice; harness new technologies to empower patients and their caregivers in collaborative knowledge development, particularly related to the social network technologies; and evaluate innovative methodologies that recognize human–computer interface factors

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Describe general data and computer applications related to research in nursing, including proposal development and project implementation in both quantitative and qualitative research (*computer use in research*)
- Summarize a range of computer-based, Web-innovations, tablet and mobile applications that facilitate or support the steps of the research process, including data collection, data management and coding, data analysis, and results reporting
- Compare and contrast select computer software applications that can be used in quantitative and qualitative research data analysis related to the steps of the research process
- Describe specific research studies in the literature that exemplify quantitative and qualitative methodologies on computer applications in healthcare
- Describe general categories of research that focuses on computer use in healthcare, from clinical applications and informatics integration to health and wellness (*nursing research on computer use*)
- Introduce the new emphasis on "big data" and the growing interest in analysis of existing data to answer research questions on populations
- Describe the drivers for promoting informatics research and computer applications today for improving safety and quality of healthcare in the future (*research on nursing informatics*)

Teaching Tip

Ask the students to define the keywords

- Nursing informatics research
- Research process
- Research methodology
- "Big data"
- Quantitative
- Qualitative
- Data collection
- Data mining
- Data management
- Data analysis
- Research applications
- Computer applications
- Internet research
- Secondary analysis
- Meta-analysis

CHAPTER REVIEW QUESTIONS

Question 47.1: What are the six common components—tools and resources—employed throughout the research process:

a. Refinement of the idea, development of methods, capturing the data, analyzing the results, disseminating the findings, and selecting a nursing terminology

b. Selecting a nursing terminology, selection of approaches, development of methods, capturing the data, analyzing the results, and disseminating the findings

c. Refinement of the idea, selection of approaches, development of methods, capturing the data, analyzing the results, and disseminating the findings

d. Refinement of the idea, selection of approaches, development of methods, capturing the data, selecting a nursing terminology, and analyzing the results

Question 47.2: What must one understand on how computer and nursing research coexist?

a. One must understand underlying terminologies, sources of information, and data elements in the nursing environments

b. One must understand informatics research

c. One must understand underlying terminologies, sources of data, communication of the information, and elements in the nursing environments

d. One must understand the elements in the nursing environments

Question 47.3: What are some of the new technologies which have enhanced the research process?

a. Personal computers, wireless technologies, cloud computing, text processing software, and new data processing applications

b. Super computers, wireless technologies, cloud computing, text processing software, and new data processing applications

c. Personal computers, electronic index cards, cloud computing, text processing software, and new data processing applications

d. Personal computers, wireless technologies, mainframe storage, text processing software, and new data processing applications

Question 47.4: Identify whether the statement refers to: (1) quantitative or (2) qualitative research methodology.

a. Research proposal must be fully developed before collecting any data (1)____X or (2)____

b. Theories used are tested from the subject's point of view (1)____ or (2)_____X

c. Knowledge developed is generated from participant's experiences (1) ___ or (2) ____X

d. Functions of philosophical data evolve into meaningful interpretations (1)___ X or (2)_____

e. Statistical packages are the mainstay for methodologists (1) ___X or (2)_____

Question 47.5: Which method best serves as an online research quantitative data collection tool?

- **a.** Input online paper-and-pencil narrative text directly into the computer to be analyzed
- **b.** Data entry by patients and sent via snail mail
- **c.** Social media-blogs provide sources of data calculations
- **d.** Web surveys that represent high cost and minimal benefits

Question 47.6: From what devices can the collection of patient physiologic parameters be collected?

- **a.** Cardiac monitoring heart rhythm, digitized imaging, clinical diagnostic measurement systems, and data mining
- **b.** Pulmonary capacity devices, digitized imaging, data mining, and clinical diagnostic measurement systems
- **c.** Data mining, cardiac monitoring heart rhythm, pulmonary capacity devices, digitized imaging
- **d.** Cardiac monitoring heart rhythm, pulmonary capacity devices, digitized imaging, and/or clinical diagnostic measurement systems

Question 47.7: What best describes how coding data is used in quantitative studies?

- **a.** Data are always collected in a narrative text
- **b.** Numerical values are entered in designated fields regardless of source to ensure accuracy
- **c.** Imaging measurements are directly obtained from a computer program
- **d.** Mechanisms are used to translate source data for analytics

Question 47.8: What best describes how data analysis is conducted in quantitative studies.

- **a)** Technique used to apply statistical procedure to make narrative text
- **b)** Statistical procedures used to translate text into meaningful data
- **c)** Different statistical procedures used depending on goal of the research
- **d)** Statistical examinations are used for descriptive or exploratory analyses
- **e)** Modeling used to confirm hypothesis testing

Question 47.9: What type of computer software is best used for qualitative research?

- **a.** Word processing programs make it possible to analyze data
- **b.** Software that can be used for analyzing qualitative data, for example, Ethnograph
- **c.** Concept diagrams used to represent numeric data
- **d.** Mapping tools software used for interviewers' responses

Question 47.10: What is the best way to disseminate research findings?

- **a.** Published as new nursing application, publication in journals and monographs, publication in online journals, and presentations on professional organization's Web sites
- **b.** Presentations at professional meetings, publication in journals and monographs, publication in online journals, and presentations on professional organization's Web sites.
- **c.** Presentations at professional meetings, publication in journals and monographs, publication in online journals, and published as a new nursing application
- **d.** Presentations at professional meetings, publication in journals and monographs, published as a new nursing application, and presentations on professional organization's Web sites

ANSWERS AND EXPLANATIONS

Question 47.1: (c) Refinement of the idea, selection of approaches, development of methods, capturing the data, analyzing the results, and disseminating the findings. The investigators must also be well prepared in a variety of computerized techniques for research activities as they are employed in the domain of knowledge that will be investigated. Without the power of technology contemporary research would not reach the level of sophistication required to discover and understand health and illness today.

Question 47.2: (c) One must understand underlying terminologies, sources of data, communication of the information, and elements in the nursing environments. New opportunities to mine existing data for evaluation and discovery are forming a bridge between the process of conducting research and the products of discovery. What is also of importance for computer use in nursing as the research on computerized applications and nursing informatics which is revolutionizing how health information is documented in the electronic health record and producing pools of searchable secondary data waiting to be tapped.

Question 47.3: (a) Personal computers, wireless technologies, cloud computing, text processing software, and new data processing applications. The computer has been a tool for researchers in many aspects of the research process and had gone beyond its historic application once limited to number crunching and business transactions. The newer technologies have become part of the researchers' world. The wireless technologies are ubiquitous and connect people to people as well as researchers to devices.

Question 47.4:

a. Research proposal must be fully developed before collecting any data (1)____X or (2)____

b. Theories used are tested from the subject's point of view (1)____ or (2)_____X

c. Knowledge developed is generated from participant's experiences (1) ___ or (2) ____X

d. Functions of philosophical data evolve into meaningful interpretations (1)___ X or (2)_____

e. Statistical packages are the mainstay for methodologists (1) ___X or (2)_____

The important distinction between the quantitative and qualitative research methodologies is that for a quantitative study to be successful the researcher is obliged to fully develop each aspect of the research proposal before collecting data whereas for qualitative research to be successful the researcher is obligated to allow the data collected to determine the subsequent steps as it unfolds in the process and/or the analysis.

Question 47.5: (a) Online paper-and-pencil narrative text directly input into the computer to be analyzed. Data collection can take a number of forms depending on the type of research and variables of interest for solving the problem. There are also unique automated data capturing applications that have been developed recently that facilitate large group data capture in single contacts or allow paper versions of questionnaires to be scanned directly into a database ready for analysis or provided online with Web-based survey tools.

Question 47.6: (d) Cardiac monitoring heart rhythm, pulmonary capacity devices, digitized imaging, and/or clinical diagnostic measurement systems. Computers can also be used to capture physiologic data. Some of these parameters can be measured directly from patient devices as well as captured form the patient electronic records. In hospitals mechanisms have been developed from intensive care unit data to calculate benchmark for mortality and resource use.

Question 47.7: (b) Numerical values are entered in designated fields regardless of source to ensure accuracy. Coding man be generated by a computer program from measurements directly obtained through imaging or physiological monitoring or entered into a computer by a patient or researcher from a printout or a questionnaire or survey into a database program. Most programs contain data editors that permit entry of data where fields are designated and numerical values entered in the appropriate fields.

Question 47.8: (b) Statistical procedures used to translate text into meaningful data. Data analysis conducted in quantitative studies generally combines a variety of techniques that apply statistical procedures with the researcher's cognitive organization of research questions, results, and visual or textual information translated into tables, charts, and graphs to make the data meaningful.

Question 47.9: (b) Software that can be used for analyzing qualitative data, for example, Ethnograph. The computer becomes a different kind of tool for the researcher in most aspects of the research beginning with the capture and recording of narrative or textual data. Qualitative research requires narrative content analysis and uses specific software packages for data analysis which interface with most popular word processing software. Ethnograph gave users a project management interface with functions to code, edit, and search data.

Question 47.10: (b) Presentations at professional meetings, publication in journals and monographs, publication in online journals, and presentations on professional organization's Web sites. The dissemination of research data continues to occur by traditional means, however, online reporting is becoming increasingly common. Some Web site frequented by nurses include online peer-reviewed journals such as *Online Journal of Nursing Informatics*. Selected articles on various Web sites such as the ANA; nursing forums sponsored by various professional organizations such as STTI, AJN, or NLN often allow participants to chat with presenters or authors of certain articles.

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Information Literacy and Computerized Information Resources

• OBJECTIVES

1. Define information literacy.
2. Identify steps in choosing appropriate databases.
3. Identify steps in planning a computer search for information.
4. Identify sources of information for practicing nurses.
5. Identify the difference between essential and supportive computerized resources.

• KEY WORDS

Information literacy
Information retrieval
Information resources
Health reference databases

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Why is it important for nurses to have search skills? How do you conduct a review of the literature? Can you describe the process? Do you consult a librarian when conducting a search? What are search terms or keywords? How do you identify search terms to begin the literature search? How do you combine search terms to narrow the search?

For a WIIFM statement, say to the class, "This chapter presents information about electronic resources that are easily available and accessible and can assist nurses in maintaining and enhancing their professional practices. These resources, aid in keeping current with the published literature, in developing a list of sources for practice, research, and/or education, and in collaborating with colleagues. To maintain professional credibility, nursing professionals must (1) keep current with the published literature, (2) develop and maintain a list of bibliographic and other sources on specific topics of interest for practice, research, and/or education, and (3) collaborate and network with colleagues regarding specifics of professional practice. Electronic resources are available to meet each of these needs. This chapter addresses each of these requirements for professional credibility and discusses both essential and supportive computerized resources available to meet them. For the purposes of this chapter, selective resources are identified and discussed as examples of the types of information available. Web site URLs of the various resources are included as well. It is important that the nursing professional determine her or his exact requirements before beginning the search. Planning the search will be stressed throughout this chapter." As a nurse, it is important to understand and utilize electronic resources relevant to healthcare and to conduct a literature search.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
   - **a.** This chapter presents information about electronic resources that are easily available and accessible and can assist nurses in maintaining and enhancing their professional practices
     - **(1)** These resources aid in keeping current with the published literature, in developing a list of sources for practice, research, and/or education, and in collaborating with colleagues
   - **b.** As is evidenced in earlier chapters, nurses use computers for many purposes
     - **(1)** In the past, most of the focus has been on computerized patient records, acuity systems, and physician ordering systems
     - **(2)** One of the major purposes for which computers can be used, however, is searching for information
     - **(3)** Many resources are available by computer, and the information retrieved can be used to accomplish different ends
     - **(4)** Computers also are available in various sizes, improving portability and availability wherever a nurse is practicing
     - **(5)** Many of the resources described in the following sections will be available via mobile devices
   - **c.** To maintain professional credibility, nursing professionals must (1) keep current with the published literature, (2) develop and maintain a list of bibliographic and other sources on specific topics of interest for practice, research, and/or education, and (3) collaborate and network with colleagues regarding specifics of professional practice
     - **(1)** Electronic resources are available to meet each of these needs
     - **(2)** This chapter addresses each of these requirements for professional credibility and discusses both essential and supportive computerized resources available to meet them
     - **(3)** *Essential* computerized resources are defined as those resources that are vital and necessary to the practitioner to accomplish the specific goal
     - **(4)** In the case of maintaining currency, for example, these resources include bibliographic retrieval systems such as MEDLINE or the CINAHL database, current awareness services, review services, or point-of-care tools and may be accessible on the World Wide Web
     - **(5)** *Supportive* computerized resources are those that are helpful and interesting and supply good information but are not necessarily essential for professional practice
     - **(6)** In meeting the requirement of maintaining currency, supportive computerized resources include document delivery services, electronic publishers, and metasites on the World Wide Web
     - **(7)** There are many resources available to meet each of the above requirements for professional credibility
     - **(8)** For the purposes of this chapter, selective resources are identified and discussed as examples of the types of information available
     - **(9)** Web site URLs of the various resources are included as well
     - **(10)** It is important that the nursing professional determine her or his exact requirements before beginning the search
     - **(11)** Planning the search will be stressed throughout this chapter

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Information-Seeking Behavior of Registered Nurses

1. **Overview**
   - **a.** Multiple practice standards organizations (Institute of Medicine [IOM], Agency for Healthcare Research and Quality [AHRQ], American Nurses Credentialing Center's [ANCC] Magnet Recognition Program, American Association of Colleges of Nursing [AACN], National League for Nursing [NLN], The Joint Commission [TJC]) insist that nursing care be based on information derived from best practice evidence
     - **(1)** To identify the best evidence and apply it in the care of the patient, the nurse must apply the information literacy process
       - **i.** Recognize the need for evidence
       - **ii.** Know how to search and find relevant information
       - **iii.** Access, utilize, and evaluate such information within the practice environment
   - **b.** Information literacy is identified as a competency for the basic nurse
     - **(1)** The American Library Association describes the "information literate" person as one who can "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" and identifies it as a basic competency for higher education
   - **c.** While the importance of maintaining currency with published literature is stressed, research has indicated that nurses often do not access the tools needed to do so
     - **(1)** Neither do they have the ability to utilize these tools, if available, within their work setting
     - **(2)** A national study of 3000 nurses licensed to practice in the United States was conducted in 2004 to better understand the readiness of nurses to utilize evidence-based nursing practice, based on their information literacy knowledge and competency
   - **d.** This landmark study demonstrated that many nurses were not aware that they needed information; once they recognized a need, online resources available for them to use were inadequate and respondents had not been taught how to use online databases to search for the information they needed
     - **(1)** Additionally, they did not value research as a basis on which to formulate and implement patient care

e. Since these findings were published, many subsequent studies have been conducted in various specialty areas and countries with similar results

  (1) Melnyk and Fineout-Overholt surveyed randomly selected members of the American Nurses Association and found that over 70% of respondents either needed or strongly needed (1) tools to implement evidence-based practice, (2) online education and skills-building modules in evidence-based practice, and (3) an "online resource center where best EBPs for patients are housed and experts are available for consultation"

  (2) Melnyk and Fineout-Overholt determined that nurses valued and were ready to practice nursing based on evidence, but need several things to be able to do so: more time, knowledge, skills, access, and a supportive organizational culture

f. The rate of expansion in health information technology (e.g., electronic health records) is phenomenal; additionally, clinical knowledge is multiplying exponentially and dissemination methods are changing to include scholarly databases and social networking

  (1) Despite the demands for EBP, nurses continue to have difficulty finding information they need for practice and prefer colleagues as their primary source

g. Nurses—students, clinicians, educators, and managers—must develop efficient and effective search strategies that embrace information literacy as a framework to search the myriad of information resources available for evidence

  (1) According to recent efforts, education is embracing the change by embedding well-designed courses that offer opportunities to develop these skills throughout program curricula

  (2) Results indicate that such courses are indeed effective in improving the nurse's skills and confidence in searching for evidence

  (3) Change in practice culture is needed to infuse information literacy throughout the workplace

h. The resources and search strategy introduced in this chapter provide the reader with tools that will become the basis of life-long learning for the nurse—tools for evidence-based practice

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Maintaining Currency with the Published Literature

1. Overview

a. It is obvious that one of the most important obligations a nurse must meet is to maintain currency in her or his field of practice

  (1) With the extreme demands in the clinical environment—both in time and amount of work—nurses need easily accessible resources to answer practice-related questions and ensure that they are practicing with the latest and most evidence-based information

  (2) Information is needed about current treatments, trends, medications, safety issues, business practices, and new health issues, among other topics

b. The purpose of the information retrieved from the sources listed below is to enable nurses to keep abreast of the latest and most evidence-based information in their selected field

  (1) Both quantity *and* quality must be considered

  (2) When using a resource, check that

    i. The resource covers the required specialty/field

    ii. The primary journals and peripheral material in the field are included

    iii. The resource is updated regularly and is current

    iv. The resource covers the appropriate period

    v. The resource covers material published in different countries and languages

    vi. There is some form of peer review, reference checking, or other means of evaluation

2. Essential computerized resources

a. Essential computerized resources for maintaining currency include bibliographic retrieval systems for the journal literature, current awareness services, review services of the journal literature, point-of-care tools, and currently published books

  (1) All of these assist the nurse in gathering the most current and reliable information

3. Bibliographic retrieval systems

a. One of the most useful resources for accessing information about current practice is the journal literature

  (1) Although there may be a delay between the writing and publishing of an article, this time period is seldom more than a few months

  (2) The best way to peruse this literature is through a bibliographic retrieval system, since there is far too much literature published to read it all

  (3) Bibliographic retrieval systems also allow filtering and sorting of this vast amount of published material

b. A bibliographic retrieval system database allows the nurse to retrieve a list of citations containing bibliographic details of the material indexed, subject headings, and author abstracts

  (1) The nurse can search these systems using specific subject headings or keywords

  (2) Most bibliographic retrieval systems have a controlled vocabulary, also known as a thesaurus or subject heading list, to make electronic subject searching much easier

  (3) For this reason, the vocabulary is geared toward the specific content of the database

  (4) These controlled vocabularies are made available online as part of the database

  (5) Keyword searching is necessary when there are no subject headings to cover the concepts being searched

  (6) The nurse can also search by specific fields, including author, author affiliation, journal title, journal serial number (ISSN), grant name or number, or publication type

    - **(7)** In bibliographic retrieval systems, most fields in the records are word-indexed and can be searched individually to retrieve specific information
- **c.** Previously available as print indexes, these systems are now available electronically through online services, or via the World Wide Web
    - **(1)** To access them, a computer with a modem, and/or Internet access is required
- **d.** Since each of these bibliographic retrieval systems has its own specific content, a nurse may have to search several systems to retrieve a comprehensive list of citations on a particular topic
    - **(1)** Directories of descriptions of bibliographic retrieval systems can be found at many sites on the World Wide Web, for example, universities (University of California, San Francisco), medical centers (University of Kansas Medical Center A. R. Dykes Library), and government agencies (National Library of Medicine)
    - **(2)** The main bibliographic retrieval systems that should first be considered are MEDLINE/PubMed, the CINAHL database, Mosby's Index, ERIC, PsycINFO, the Social Sciences Citation Index, and SocIndex
- **e.** *MEDLINE/PubMed.* The NLM provides free access to many online resources

Teaching Tip
See Table 48.1.

    - **(1)** One of these, MEDLINE, covers 5600 journals in 39 languages with over 20 million references from 1946 to the present in the fields of medicine, nursing, preclinical sciences, healthcare systems, veterinary medicine, and dentistry
    - **(2)** The nursing subset in MEDLINE covers 189 nursing journals
    - **(3)** The database is updated weekly on the World Wide Web
    - **(4)** The NLM's databases use a controlled vocabulary (thesaurus) called MeSH (Medical Subject Headings)
    - **(5)** These index terms facilitate subject searching within the databases
- **f.** MEDLINE and the nursing subset are available free over the World Wide Web through the NLM's home page
    - **(1)** There are two ways to search this database: PubMed and the NLM Gateway
    - **(2)** The NLM Gateway is a Web-based system that allows users to search multiple NLM retrieval systems simultaneously
    - **(3)** The database is also available through the commercial vendors mentioned below
    - **(4)** All of these options allow the nurse to search by subject, keyword, author, title, or a combination of these

Teaching Tip
An example of different searches with a display using the EBSCOhost interface is shown in Figs. 48.1 and 48.2.

- **g.** Loansome Doc allows the nurse to place an order for a copy of an article from a medical library through PubMed or the NLM Gateway
    - **(1)** The full text of articles for some journals is available via a link to the publisher's Web site from the PubMed abstract or record display
    - **(2)** Some of the full text is available free of charge
    - **(3)** The links indicating free full-text display on the Loansome Doc order page prior to order placement and on the Loansome Doc Order Sent page immediately after the order is finalized
    - **(4)** NLM has a fact sheet for Loansome Doc users covering the registration process, how to place an order, order confirmation, check order status, and updating account information
- **h.** *CINAHL*
    - **(1)** The CINAHL database, produced by Cinahl Information Systems, a division of EBSCO Information Services (EBSCO), provides comprehensive coverage of the literature in nursing and allied health from 1982 to the present
    - **(2)** CINAHL has expanded to offer five databases including three full-text versions
    - **(3)** The database covers chiropractic, podiatry, health promotion and education, health services administration, biomedicine, optometry, women's health, consumer health, and alternative therapy
    - **(4)** More than 4900 journals, as well as books, pamphlets, dissertations, and proceedings are indexed
    - **(5)** Some journals covered are published in other countries
    - **(6)** It is updated weekly
- **i.** The CINAHL database also uses a controlled vocabulary for effective subject searching
    - **(1)** The CINAHL *Subject Heading List* uses the NLM's MeSH terms as the standard vocabulary for disease, drug, anatomic, and physiologic concepts
    - **(2)** There are approximately 12,714 unique CINAHL terms for nursing and the allied health disciplines
    - **(3)** Specific field searching and quality filters are available in the CINAHL database and are similar to those found in MEDLINE

Teaching Tip
An example of different searches with a display using the EBSCOhost interface is shown in Figs. 48.3 and 48.4.

- **j.** An essential part of research papers is the list of references pointing to prior publications
    - **(1)** Cited references for more than 1300 nursing and allied health journals are searchable in the CINAHL database
- **k.** *Mosby's Index*
    - **(1)** Content from over 3150 peer-reviewed journals, trade publications, and electronic titles, and provides access to over 3 million records, as far back as 1974, is indexed in this database

    - **(2)** It uses the EMTREE Thesaurus, a hierarchically structured, biomedical thesaurus, which has been enhanced for nursing
    - **(3)** Both the thesaurus and the index are published by Elsevier B.V.
- **m.** *ERIC*
    - **(1)** The ERIC (Educational Resources Information Center) database is sponsored by the Institute of Education Sciences (IES) of the US Department of Education and contains more than 1,400,000 citations covering education-related literature
    - **(2)** It covers virtually all types of print materials, published and unpublished, from 1966 to the present day
    - **(3)** Currently, more than 650 journal titles are indexed in ERIC
    - **(4)** It is updated monthly
    - **(5)** This database gives the nurse a more comprehensive coverage of education than any other bibliographic retrieval system
    - **(6)** The *Thesaurus of Eric Descriptors*, a controlled vocabulary, assists with computer searches of this database on the Internet through the World Wide Web (ERIC)
    - **(7)** As with the other two bibliographic databases mentioned, nurses are able to access all of the data in each record on ERIC by searching, using subject headings or keywords, or by searching for a word(s) in a specific field
- **n.** *PsycINFO*
    - **(1)** The PsycINFO database, produced by the American Psychological Association, provides access to psychologically relevant literature from more than 2543 journals, dissertations, reports, scholarly documents, books, and book chapters with more than 3 million references from the 1880s to the present
    - **(2)** Updated weekly, most of the records have abstracts or content summaries from material published in over 49 countries
    - **(3)** Using the *Thesaurus of Psychological Index Terms* of more than 8400 controlled terms and cross references, the nurse can search for specific concepts effectively
    - **(4)** Keyword and specific field searching are also available
- **o.** *Social Sciences Citation Index*
    - **(1)** This database can be accessed via Web of Science for a fee
    - **(2)** Web of Science includes a broad range of databases offering "multidisciplinary coverage from more than 12,000 high impact research journals worldwide"
    - **(3)** This particular index was developed by the Institute for Scientific Information and is a multidisciplinary citation index which covers more than 3000 journals in the social, behavioral, and related sciences
    - **(4)** The nurse can search the cited references as in the citation index in the CINAHL database
- **p.** *Google Scholar*
    - **(1)** Google Scholar (GS) offers a version of the Google search engine with which most nurses are familiar
    - **(2)** In fact, approximately 67% of the more than 170 billion Internet searches each month are conducted using Google
    - **(3)** Like PubMed, GS is free to access and use and links to some full text articles
    - **(4)** It offers broad search capability across many disciplines and types of literature, including articles from scholarly journals, theses, books, Web sites, and court opinions
    - **(5)** This capability may be useful in an initial search on a topic to get an overview, but may not be precise enough for a specific search
    - **(6)** Limited advance search capability is available, but a searcher cannot limit to a specific resource type (e.g., research, clinical trial) or discipline
    - **(7)** Good analytical and evaluative skills are essential
    - **(8)** GS is not a replacement for the above-described academic databases, but one to be used in conjunction with them
    - **(9)** It may also be particularly useful for nurses who do not have easy access to a hospital or academic library where such databases are typically housed
    - **(10)** Of particular note when searching GS are the "Cited by" and "Related articles" options with each citation
    - **(11)** It is possible to examine the development and direction of a concept, idea, or innovation by seeing citations of other authors referring to a given article
    - **(12)** Authors can also easily find where their work has been cited
- **q.** A few other bibliographic retrieval systems to keep in mind are databases such as
    - **(1)** The database AgeLine owned by EBSCO
    - **(2)** The Excerpta Medica database EMBASE
    - **(3)** The National Technical Information Service NTIS database
    - **(4)** The UMI Proquest Digital Dissertations

4. Current awareness services

- **a.** Most bibliographic retrieval systems are updated weekly or monthly
    - **(1)** In addition to the delay between the writing and publishing of the material that is indexed in the database, there is also a delay between the receipt of material, the indexing, and finally the inclusion of the citations for the indexed material in the database
    - **(2)** To obtain access to more current material than that available in a bibliographic database, the nurse should use a current awareness service
- **b.** Current awareness services are helpful when used in addition to bibliographic retrieval systems
    - **(1)** These services provide access to tables of contents of journals and allow individuals to request articles of interest
    - **(2)** They may include not only journal articles, but also proceedings from conferences, workshops, symposia, and other meetings
    - **(3)** Often, hospital or university librarians may provide these services as well

   (4) Unlike the bibliographic databases, where subject searching using controlled vocabulary is available, only keyword searching for the subject, author, title, or journal is available in current awareness services or databases

c. Some current awareness services or databases are Current Contents Connect, the in-process database for MEDLINE (formerly PREMEDLINE), and the PreCINAHL records on EBSCOHost

   (1) Current Contents Connect from Thomson Reuters, provides a Web-friendly current awareness service to tables of content, abstracts, and bibliographic information from the most recently published scholarly journals as well as from more than 7000 relevant, evaluated Web sites

   (2) PubMed's in-process records (formerly PREMEDLINE) provide basic information and abstracts before the citations are indexed and are found as part of a topic search

d. The PreCINAHL records offered by Cinahl Information Systems, a division of EBSCO, publishers of the CINAHL database, are available on EBSCOHost and provide a method to access basic information, abstracts, and sometimes full text before the citations are formally indexed

   (1) The records are retrieved as part of a topic search. They can also be excluded from a topic search

e. The second type of current awareness provided by Cinahl Information Systems is within the bibliographic database itself, where the searcher is able to choose from a group of 36 specific or special interest categories, which actually function as "virtual" databases

   (1) Possibilities include such areas as advanced nursing practice, case management, home healthcare, or military/uniformed services

   (2) By selecting one of these categories, documents are retrieved that are either in specific journals in the field or have been selected by indexers as being of interest to those in that field

   (3) The results can be limited by any of the available limits on the database, for example, publication type such as research, journal subset such as blind peer reviewed, and the presence of full text

   (4) A nurse with limited time can peruse the latest literature in one of these fields in this way

Teaching Tip
See Figure 48.5.

5. Review services

a. Although the bibliographic retrieval systems and the current awareness services and databases act as filters to the ever-exploding volume of literature, sometimes the information retrieved needs to be evaluated to determine whether or not it is appropriate

Teaching Tip
For example, a monthly literature search might be done on a bibliographic and current awareness database and then a review service checked for commentaries on the sources retrieved.

   (1) Supportive computerized resources that synthesize the literature include the Joanna Briggs Institute for Best Practice

   (2) Clinical Evidence (BMJ Publishing) or the Cochrane Library Database of Systematic Reviews

   (3) Review services such as Doody's Review Service or reviews noted in bibliographic databases or review journals, such as, *Evidence-Based Nursing, Evidence-Based Practice, Best Practice,* and *ACP Journal Club* can also be used to evaluate sources

   (4) Review services provide information to searchers about recently published books, journal articles, audiovisuals, and software

   (5) These reviews may also include ratings, opinions, or commentaries about the material

b. Doody's Review Service is a service in which members develop a profile and a weekly bulletin is e-mailed describing books and software that meet the parameters of the profile

   (1) According to the Web site, the service currently contains over "130,000 book, eBook, and software titles in 140 specialties"

   (2) The searcher can use author names, title, specialty, publisher, and keywords to find books of interest

   (3) The results show price, ISBN, and publisher as well as a rating, when available

   (4) Materials are rated using a star system and a questionnaire that assesses the extent to which objectives are met and the appropriateness of the work's readability, among other criteria

   (5) The information presented allows serious consideration of the book along with information to assist in making choices

c. It is well-known that books are generally long in the development stage and are not as current as journal articles or documents on the World Wide Web; however, the *depth* of material presented in books must be considered

   (1) An in-depth discussion of *all* aspects of cardiac rehabilitation, for example, may be valuable in planning care and would probably not be included in a journal article where space is a consideration

   (2) Yet it would still be necessary for maintaining currency in the field

6. Point-of-care resources

a. Point-of-care resources are resources that support patient care at the bedside

   (1) Lists of these resources are available

b. *Mosby's Nursing Suite*

   (1) Mosby's Nursing Suite from Elsevier includes Mosby's Nursing Consult, Mosby's Nursing Skills, and Mosby's Index (discussed earlier)

   (2) Mosby's Nursing Consult provides information to help nurses with patient care

   (3) The database includes evidence-based nursing monographs, nursing journals and clinics, nursing and medical reference texts, practice guidelines, images, drug information, and several thousand customizable patient handouts

  - **(4)** Mosby's Nursing Skills is an online skills reference and competency management resource from Elsevier
  - **(5)** There are over 1300 nursing skills that use a learning management system (LMS) which allows nurse managers and educators to assign, track and manage skills, and test hospital staff
- **c.** *Nursing Reference Center*
  - **(1)** Nursing Reference Center (NRC), published by EBSCO, is a point-of-care tool designed to provide relevant clinical resources to nurses and other healthcare professionals
  - **(2)** The database offers staff nurses, nurse administrators, nursing students, nurse faculty, and hospital librarians the best available and most recent clinical evidence from thousands of full-text documents
  - **(3)** NRC contains over 3600 Quick Lessons and Evidence-Based Care Sheets covering conditions and diseases, cultural competencies, patient education resources, drug information, continuing education (CE), lab and diagnosis detail, legal cases, research instruments, and best practice guidelines
  - **(4)** Quick Lessons are clinically organized nursing overviews of diseases and conditions
  - **(5)** They represent the best available evidence and are designed to match the nursing work flow
  - **(6)** They provide nurses with information the nurses need about diseases, including
    - **i.** A description of the disease
    - **ii.** Its signs and symptoms
    - **iii.** Typical tests the clinician will order to diagnose it, or measure progress in treating it
    - **iv.** The interventions nurses will likely be involved in while the patient is in their care
    - **v.** Information necessary to share with the patient/patient's family
- **d.** Evidence-Based Care Sheets provide evidence about aspects of a disease or a condition in terms of what we know about it and what we can do about it
  - **(1)** The evidence is coded as to its strength so the user can evaluate it and determine its applicability to their practice
- **e.** In the database, there are nearly 1200 nursing skills and procedures, providing access to clinical papers detailing the necessary steps to achieve proficiency in a specific nursing task
  - **(1)** Skill Competency Checklists are provided with these documents
  - **(2)** Many papers are also available that define key considerations to providing culturally competent care to specific population groups
- **f.** Point-of-care reference books include
  - **i.** *Davis's Comprehensive Handbook of Laboratory & Diagnostic Tests with Nursing Implications*
  - **ii.** *Taber's Cyclopedic Medical Dictionary*
  - **iii.** *Davis's Drug Guide for Nurses*; *AHFS Drug Essentials*
  - **iv.** *Diseases and Disorders: A Nursing Therapeutics Manual*
  - **v.** And more
- **g.** There are more than 3600 evidence-based customizable patient handouts (English and Spanish) together with thousands of detailed medical illustrations
  - **(1)** Nearly 1400 CE modules are also available
  - **(2)** These modules are accredited through the ANCC and the International Association for Continuing Education and Training (IACET)
  - **(3)** Over 30 CE modules have been accredited by the Commission for Case Manager Certification
- **h.** Users can search NRC by entering keywords in the Find field and then clicking on the Search button
  - **(1)** NRC will display a Result List that is sorted by source type

Teaching Tip
For example, Quick Lessons, Skills, Evidence-Based Care Sheets, Drugs, etc.

  - **(2)** Users can search the database using the standard nursing process ADPIE (assessment, diagnosis, planning, implementation, evaluation)
  - **(3)** Nursing process limiters are used to clarify a search in NRC
  - **(4)** Users can select one or multiple nursing process limiters to rapidly target applicable content
- **i.** Users can launch a *CINAHL*-type search, and limit searches by document types, full-text, publication date, or source
  - **(1)** They can also browse CINAHL headings or indexes and other EBSCOhost databases that may be subscribed to by the institution
  - **(2)** Users can store search results, persistent links to articles, images, saved searches, alerts, and Web pages to pull in the latest information needed on the floor and to create department-specific patient education packets
- **j.** A Nursing Reference Center "app" is available for the iPhone, iPad, and iPod Touch for nurses who wish to access it via those devices

7. Supportive computerized resources

- **a.** Supportive computerized resources that assist the nurse in maintaining currency provide additional information and enhance the value of the essential computerized resources described previously
- **b.** Obtaining a bibliographic list of citations is only the first step in obtaining information on a particular topic
  - **(1)** After carefully evaluating the citations, either from the title and/or the abstracts, or after using one of the review processes described previously, the nurse will need to get the full text of the sources retrieved
  - **(2)** Many articles are available in full text directly through the bibliographic databases searched
  - **(3)** If not, a local library or academic institution would be a place to go to locate the items retrieved in a search
- **c.** *Document delivery services*
  - **(1)** Publishers of journals or books, database vendors and providers (NLM, American Psychological Association, Ovid Technologies, EBSCO, Proquest Information and Learning), and document delivery services are

secondary sources through which full text of items can be obtained for a fee

- **(2)** Fees differ depending on the service, the urgency of the request, and the publisher's charges
- **(3)** Copy is usually sent via fax, mail, or electronic delivery
- **(4)** Many libraries provide document delivery for each other through services such as DocLine, an automated interlibrary loan (ILL) request routing and referral system provided through the National Library of Medicine

d. *Electronic publishers*

- **(1)** Many publications are now being published electronically, either as an "e-journal" only or as a print journal with electronic supplements
- **(2)** There are several advantages to this form of publication such as speed, ease of availability, and space required for publication
- **(3)** Searching for information in these journals is relatively easy
- **(4)** The *Morbidity and Mortality Weekly Report (MMWR),* published by the Centers for Disease Control and Prevention, is one such electronic publication that can be subscribed to and provided by e-mail
- **(5)** The credibility and accuracy of the source of electronically published material must always be considered just as it is in print publications
- **(6)** The criteria mentioned along with additional criteria discussed later can be useful in evaluating this material
- **(7)** Two examples of electronic-only nursing journals are the *Online Journal of Issues in Nursing,* published by the American Nurses Association, and the *Online Journal of Informatics*, published in Pennsylvania
- **(8)** Other journals such as *Nursing Standard Online* have print counterparts, but may have portions that are only electronic

e. Nursing publishers and organizations have their own Web sites, which have details about new publications, sometimes the full text of some of the latest journal articles, official position statements of organizations, and/or practice guidelines

- **(1)** To identify the Web sites of nursing publishers and organizations, search Web site indexes such as Yahoo or Google, or browse Web site lists on Web sites such as that of the University of Buffalo Library or the Allnurses.com have been provided
- **(2)** On a Web site index such as Yahoo or Google, do a general search for "nursing and publishers," "nursing and organizations," or "nursing and associations" or under the specific names of the publishers and organizations (e.g., Sage, Sigma Theta Tau)
- **(3)** Advanced search options are also available

f. Lippincott Williams & Wilkins has placed over 60 journals including the

- **(1)** *AJN, American Journal of Nursing*; *Nursing Research*
- **(2)** *CIN: Computers, Informatics, Nursing*
- **(3)** *JONA: Journal of Nursing Administration*, among others, on their journals' page with issues from January 1996 to the present
- **(4)** The site has a search capability that allows keyword searching of the contents of the journals on the site
- **(5)** There are both free and fee-based articles available on the site

g. Many nursing organizations provide a significant amount of support to practicing nurses

- **(1)** They publish journals and provide these as a member benefit
- **(2)** They also provide access to the full text of their position statements and/or practicing guidelines
- **(3)** Some of these resources are the
  - **i.** American Nurses Association's Web site NursingWorld
  - **ii.** The Web sites of the American Academy of Nurse Practitioners
  - **iii.** American College of Nurse Practitioners
  - **iv.** The Association of Pediatric Hematology/Oncology Nursing
  - **v.** And many others
- **(4)** Details regarding new publications and ordering items can be found on the Web sites of most publishers

h. *Metasites on the World Wide Web*

- **(1)** Since there is so much information on the World Wide Web, identification and evaluation of Web sites is very important to determine which provide valid information
- **(2)** One of the ways to identify Web sites is to consult a metasite
- **(3)** There are several Web sites that can be classified as metasites concerning the same specific topic
- **(4)** The Hardin Meta Directory of Internet Health Sources, sponsored by the Hardin Library for the Health Sciences at the University of Iowa is one of these as is the National Information Center on Health Services Research & Healthcare Technology (NICHSR), a government site
- **(5)** These sites basically function as lists of lists that provide links to other subject-specific Web sites
- **(6)** Once the Web sites have been identified, it is very important to evaluate them
- **(7)** At minimum, the nurse should consider the following
  - **i.** Who created the site?
  - **ii.** Is its purpose and intention clear?
  - **iii.** Is the information accurate and current?
  - **iv.** Is the site well designed and stable?
  - **v.** How frequently is it updated?
  - **vi.** Additionally, who sponsors or benefits from the site?
  - **vii.** Is there a fee involved?
  - **viii.** Is its foundation evidence based?

i. There are also Web sites that can be used to evaluate other Web sites

- **(1)** HON (Health on the Net Foundation) is an international initiative funded by the various European entities to promote effective Internet development and use in the areas of medicine and health

(2) Other Web sites that critically evaluate sites are National Council Against Health Fraud, a voluntary health agency that focuses on health fraud; and Quack Watch, founded out of concern about health-related frauds, myths, and misconduct

(3) Additionally, Web sites providing information or discussions concerning specific diseases should be evaluated in this way (e.g., the Web sites of the American Diabetes Association, American Heart Association, and the Multiple Sclerosis Foundation)

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Developing and Maintaining a List of Sources for Research/Practice/Education

1. Essential computerized resources

a. The purpose of the information retrieved from these information resources is to enable nurses to answer specific questions that relate to research, practice, and/or education

Teaching Tip

For example:

- A staff nurse needs to find information to share with her or his colleagues on oral care and the prevention of pneumonia
- A nursing student has to finish a term paper and needs to find five nursing research studies on caring for a Hispanic patient with a myocardial infarction
- A nurse manager needs to find research studies and anecdotal material showing the best way to prevent patient falls in her or his health facility

b. *Bibliographic retrieval systems*

(1) Resources essential in answering these types of questions again include bibliographic databases as well as various Web sites

(2) Once again, the resources need to be carefully evaluated for coverage and currency

(3) Once a resource has been selected, the nurse breaks down her or his needs into a search statement such as, “I need information on oral care and prevention of pneumonia”

(4) The information on this topic would best be found in a bibliographic database

(5) On such a database, the best method of searching is to do a subject search using a controlled vocabulary (MeSH headings in MEDLINE, CINAHL subject headings in the CINAHL database, and so forth)

c. *Search strategies*

(1) One of the most important aspects of searching the literature is formulating the exact strategy to obtain the information from a resource, whether from a bibliographic retrieval system or a Web site

(2) There are six steps in planning the search strategy

i. Plan the search strategy ahead of time

ii. Break down the search topic into components. To find information on oral care and the prevention of pneumonia, remember to include synonyms or related terms. The components of the above search would be oral hygiene or mouth care and prevention of pneumonia. Sometimes the terms for the search will be subject headings in the database’s subject heading list (often called a thesaurus); in other cases, they will not be

Teaching Tip

See Figure 48.6.

iii. Check for terms in a subject heading list, if available. If the concept is new and there are no subject headings, a text word or keyword search is necessary. For example, before the term *critical path* or *critical pathways* was added to the CINAHL or MeSH Subject Heading List, respectively, it was necessary to do a text word search for this concept. A search using the broad term *case management* would have retrieved many articles that would not necessarily discuss or include critical paths. Combining the two concepts results in a more specific result: articles on case management that include critical paths

iv. Select *operators*, which are words used to connect different or synonymous components of the search. The AND operator, for example, makes the search narrower or more specific as the results of the search for two different terms will only result in records that include *both* terms as subject headings

Teaching Tip

Refer to Figure 48.7.

The OR operator can be used to connect synonymous or related terms, which broadens the search (Fig. 48.8). An example, combining subject headings using OR and AND operators is shown in Fig. 48.9. The NOT operator can be used to exclude terms (Fig. 48.10).

v. Run the search. For the search on oral care and pneumonia, select the option *explode* for the subject headings oral hygiene and mouth care. This would ensure the retrieval of articles on the broad heading and the more specific headings. For example, the specific headings under oral hygiene are “dental devices, home care” and “toothbrushing”

vi. View the results

d. *Practice guidelines and position statements*

(1) Organization-specific practice guidelines, position statements, and standards of practice can often be accessed and obtained from the Web site of an individual’s professional organization

(2) These are extremely useful documents that present information on scope of practice, qualifications, and education among other important details

(3) Additionally, Cinahl Information Systems currently includes nurse practice acts as one of its publication types in the CINAHL database

(4) These appear in full text and can be read online or printed

e. *Continuing education and computer-assisted learning*

(1) Many nurses do not have the time or money to attend conferences and workshops to keep abreast of the latest information in their specialties or to complete the necessary units or credits for CE for relicensure or recertification

(2) The World Wide Web is a wonderful source for nurses that can be used to satisfy their requirements for CE

(3) To identify CE Web sites visit the Nursefriendly National Consumer Health Directories, or use one of several search engines to obtain CE nursing sites

(4) There are many nursing sites or point-of-care resources that offer online CE and CEU certificates, such as Nursing Reference Center through EBSCO, RnCeus.com, and the CE Connection at Lippincott Williams & Wilkins site

(5) A directory of free online CE opportunities for nurses can be found at nurseCEU.com

f. As mentioned at the beginning of this chapter, nurses use computers for many purposes

(1) Computer-assisted instruction (CAI), computer-assisted learning (CAL), and interactive videodisc (IVD) provide easy learning experiences using a computer

2. Supportive computerized resources

a. Supportive computerized resources that assist in practice, research, and education contain all types of health information, including drug and treatment information, anatomy, and physiology

(1) Specific products such as the *Merck Manual of Diagnosis and Therapy* or the *Physician's Desk Reference* available as *PDRhealth* are also available on the World Wide Web

(2) The Visible Human Project includes complete, anatomically detailed, three-dimensional representations of the male and female human bodies

(3) The National Library of Medicine itself claims to be the "largest health science library in the world"

b. Other Web sites of particular interest in this category include the Nursing Theory Page and the Virginia Henderson Global Nursing e-Repository as well as the Interagency Council on Information Resources in Nursing (ICIRN)

(1) ICIRN prepares a list of "Essential Nursing Resources" which are available online

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Collaboration and Networking Regarding Issues of Professional Practice

1. Overview

a. Nurses frequently gather information from their personal networks—either at the worksite or at professional meetings

(1) The increased availability of computers makes contact with other professionals much easier, resulting in networking and collaboration possibilities heretofore impossible

(2) Information retrieved by this method enables nurses to learn from their colleagues' experiences

(3) When considering with whom to network, the specialty of the person should be evaluated along with experience, the material they have published in their field, and the research undertaken by the institution with which they are affiliated

(4) Most of this information is not published and would be unavailable through traditional information resources

b. Computerized resources for collaboration and networking vary in several technical details (e.g., their focus, the presence or absence of a moderator to monitor messages, the number of participants, and their level of interactivity)

2. Essential computerized resources

a. *Electronic mail and listservs*

(1) An important fundamental computerized resource for collaboration and networking is e-mail, which is at the core of almost any electronic communication

(2) Necessary components for e-mail are access to Internet services (often provided by cable television and local telephone companies) and e-mail viewing software, such as Internet Explorer or Firefox

(3) E-mail allows one-to-one communication between individuals and can provide immediate response to practice-related questions

b. A second essential computerized resource for collaboration is an electronic discussion group or "listserv"

(1) Listservs allow individuals to subscribe free of charge and to read and respond to messages via e-mail

(2) Since the messages are posted to all of the members, the listserv allows sharing and dissemination of information with colleagues

(3) Some listservs have a closed membership for a specific group (e.g., librarians or specific nursing groups), and some are moderated

(4) In a moderated group, an individual or group of individuals reads the messages prior to distribution to the group

(5) Subject-specific listservs include NURSENET (general nursing), Nursing-L (nursing informatics), NRSED (education issues/faculty), and NurseRes (research)

(6) Specialty listservs are very helpful in increasing dialogue between individuals within the same specialty

3. Supportive computerized resources

a. *Electronic bulletin boards, forums, newsgroups, blogs, chat rooms, and social networking sites*

    (1) Bulletin boards, forums, newsgroups, and chat rooms are examples of supportive computerized resources
    (2) Similar to a traditional bulletin board, the electronic version has an administrator who sends the discussion to various Web sites, where nurses visit to read and participate in the discussion
    (3) This format for electronic networking has almost entirely been replaced by forums and newsgroups, which have become more and more sophisticated in their interactivity and design
    (4) The premise behind each of them is similar
    (5) An individual posts a message concerning a topic (known as a thread) for others to read and respond to
    (6) Allnurses.com has a "Break Room," a general topic area in which nurses are invited to discuss anything of particular interest to them
    (7) Newsgroups operate in much the same way
    (8) Nursezone.com is an online news magazine that offers blogs, a job center, and various nurse-related information
    (9) All of these resources are interactive but on a delayed basis
    (10) An individual may respond to a message immediately or wait several days
    (11) Chat rooms, on the other hand, are interactive in real time
    (12) Conversations in chat rooms can be compared to telephone conversations
    (13) "Nursing Chat Room" in LinkedIn is an example focused especially on psychiatric nursing

b. Each of these methods of collaboration and networking provides an option for nurses to contact and build relationships with other professionals concerning issues important to them

    (1) Newer social networking sites such as LinkedIn, Facebook, and Twitter offer great potential for sharing experiences and ideas about practice issues
    (2) Using features of smartphones such as texting also enhance communication opportunities

c. All of the above sites offer end users the ability to disseminate information about practice and/or products that they have found useful

    (1) By "liking" a particular site, an end user can be included in any notifications about new information on that site

Teaching Tip

For example, a commercial entity that produces an insulin pump can create a Facebook account, post information about its operations or products, and promote itself to other account holders.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- While these three categories of information needs have been discussed as if they were independent of one another, a nurse might often find that she or he has needs that transcend all three categories or that fall under a different category each time, depending on the task
- For example, a staff nurse may need to investigate the best methods to assess and manage pain
- The process of retrieving the appropriate information would be to first search for research studies and anecdotal material on the topic of pain measurement and pain management
- This would involve a search for pain measurement or pain with therapy, drug therapy, and diagnosis using essential computerized resources such as bibliographic retrieval systems like MEDLINE or the CINAHL database
- The nurse would also consult a point-of-care tool such as Mosby's Nursing Consult or Nursing Reference Center to locate the latest evidence on a particular patient care topic
- Networking with other professionals facing the same task would be an additional step in this process
- The nursing listservs mentioned under the "Collaboration and Networking Regarding Issues of Professional Practice" section would be an important and essential resource, while e-mailing or texting colleagues who are specialists in the field of pain would be a supportive resource
- To locate specialists, a bibliographic retrieval system could be searched for research studies on pain measurement or management
- The author affiliation field in the records retrieved would help track the institution with which the author is affiliated
- Social networking sites can be useful in identifying and reviewing specialists in a given area of practice
- Making sure to keep current on any new material published on pain measurement and pain management, by using current awareness services or Web sites, would also be vital in locating information on this topic
- Bibliographic retrieval systems, already used as an essential resource, could be searched each month to assess what new material had been published on the topic
- Supportive computerized resources might include a similar search for papers on the Cochrane Library's Database of Systematic Reviews
- An important part of identifying and using these essential and supportive computerized resources is the evaluation of each of them to assess whether or not they contain the information needed
- Therefore, the nurse must determine what she or he is looking for, identify the most appropriate resources to locate the information needed, and, using the criteria discussed throughout this chapter, evaluate the resources to assess if they are valid, current, and accurate
- Finally, it is important to realize that computerized information resources are like a "moving target," in that technology is changing so quickly that resources used today may be gone, unavailable, or outdated tomorrow
- The use of bibliographic retrieval systems, search engines, and metasites encourages searching by *subject* or *concept*,

which is the most reliable way to cope with the ever-changing nature of technology

- This is vital to maintaining currency with the published literature, developing and maintaining a list of sources of topics of interest for practice, research, and/or education, and collaboration and networking with colleagues regarding issues of professional practice

Teaching Tip

Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip

Review the chapter objectives

- Define information literacy
- Identify steps in choosing appropriate databases
- Identify steps in planning a computer search for information
- Identify sources of information for practicing nurses
- Identify the difference between essential and supportive computerized resources

Teaching Tip

Ask the students to define the keywords

- Information literacy
- Information retrieval
- Information resources
- Health reference databases

CHAPTER REVIEW QUESTIONS

Question 48.1: To maintain professional credibility, nursing professionals use electronic resources to maintain and enhance their professional practices by:

a. Keeping current with published literature True ___X False ___

b. Keeping a bibliography and other sources on the topics of interest for practice, research, and education True ___X False ___

c. Collaborating and networking with colleagues regarding professional practices True ___X False ___

d. Developing an EHR for use by colleagues True ___ False ___X

e. Developing a nursing terminology True ___ False ___X

Question 48.2: What are the differences between essential and supportive computerized resources?

a. Essential computerized resources (ECR) are defined as those vital and necessary to for professional practice True ___X False ___

b. The ECR use bibliographical retrieval systems such as MEDLINE or CINAHL databases True ___X False ___

c. Supportive computerized resources (SCR) are those helpful and/or interesting but not necessary for professional practice True ___X False ___

d. The ECR use electronic publishers and/or metasites on the World Wide Web (WWW) True ___X False ___

e. The WWW requires knowledge of both ECR and SCR resources True ___ False ___X

Question 48.3: TJC insists that nursing care should be based on information derived from best practice evidence. To do so the nurse must apply the information literacy process which is to:

a. Recognize the need for evidence, know how to search and find relevant information, and assess, utilize, and evaluate the information

b. Evaluate the information, know how to search and find relevant information, and know how to look up keywords for the recognized topic

c. Recognize the need for evidence, know how to look up keywords for the recognized topic, and assess, utilize, and evaluate the information

d. Assess, utilize, and evaluate the information, know how to look up keywords for the recognized topic, and know how to access a bibliographic retrieval system for the information

Question 48.4: How is information literacy identified as a competency for the basic nurse and competency for higher education?

a. Information literate person is one who has trouble recognizing the need and has trouble locating, evaluating, and using the information effectively

b. Information literate person is one who can recognize when information is needed but does not have the ability to locate, evaluate, and use it effectively

c. Information literate person is one who can recognize when information is needed and has the ability to locate, evaluate, and use it effectively

d. Information literate person is one who does not recognize when information is needed and does not know how to use it

Question 48.5: The landmark study conducted by the ANA demonstrated that many nurses were not aware that they needed information or how to use online databases to obtain information. They found that the respondents either needed or strongly needed:

a. An online resource center with best EBPs for patients, tools to implement evidence-based practice, and nursing terminology with evidence-based actions

b. Online education and skill-building modules in evidence-based practice, an online resource center with best EBPs for patients, and nursing terminology with evidence-based actions

c. Nursing terminology with evidence-based actions, tools to implement evidence-based practice, and an online resource center with best EBPs for patients

d. Tools to implement evidence-based practice, online education and skill-building modules in evidence-based practice, and an online resource center with best EBPs for patients

Question 48.6: What are the criteria that are needed to be considered when information is retrieved from resource sources?

a. Covers required specialty/field, primary journals included, updated regularly, covers appropriate time period, is peer reviewed, and available in digital format

b. Covers required specialty/field, primary journals included, updated regularly, covers appropriate time period, covers materials published internationally, and is peer reviewed

c. Covers required specialty/field, primary journals included, available in digital format, covers appropriate time period, covers materials published internationally, and is peer reviewed

d. Primary journals included, updated regularly, is available in digital format, covers appropriate time period, covers materials published internationally, and is peer reviewed

Question 48.7: What is the most essential computer resource for a practitioner to use to become current on a specific nursing topic?

a. BRS, current awareness services, and review services

b. PowerPoint presentations and point-of-care tools, and current awareness

c. Published books, BRS, and PowerPoint presentations

d. Revised services, PowerPoint presentations, and BRS

Question 48.8: Which best describes a bibliographic retrieval system (BRS) such as CINAHL?

a. Not able to sort since a controlled vocabulary not available

b. Able to filter and sort vast amount of indexed published material

c. Published material not included in a BRS

d. Citations of the indexed bibliographic not available

e. Computer and Internet are not required to access system

Question 48.9:Which are the six steps that best represent a search strategy for searching the literature to obtain the information from a resource whether it is a BSR or Web site?

a. Review UMLS terms, break down the search topic into components, check the terms in the subject heading list, select operators, run the search, and view the results

b. Plan the strategy, review UMLS terms, check the terms in the subject heading list, select operators, run the search, and view the results

c. Plan the strategy, break down the search topic into components, check the terms in the subject heading list, select operators, compare with UMLS terms, and view the results

d. Plan the strategy, break down the search topic into components, check the terms in the subject heading list, select operators, run the search, and view the results

Question 48.10: Which are considered computerized social media resources for collaboration and networking with other professionals?

a. Blogs, WWW, electronic mail, and COBOL

b. WWW, blogs, chat rooms, and electronic mail

c. Chat rooms, social networks, COBOL, and blogs

d. Electronic mail, listservs, Fortran, and blogs

ANSWERS AND EXPLANATIONS

Question 48.1:

a. Keeping current with published literature. True ___X False ___

b. Keeping a bibliography and other sources on the topics of interest for practice, research, and education True ___X False ___

c. Collaborating and networking with colleagues regarding professional practices True ___X False ___

d. Developing an EHR for use by colleagues True ___ False ___X

e. Developing a nursing terminology True ___ False ___X

Electronic resources are available to meet each of these listed needs. Computer resources are defined as those resources that are vital and necessary to the practitioner to accomplish one of the three specific goals listed above.

Question 48.2:

a. Essential computerized resources (ECR) are defined as those vital and necessary for professional practice True ___X False ___

b. The ECR use bibliographical retrieval systems such as MEDLINE or CINAHL databases True ___X False ___

c. Supportive computerized resources (SCR) are those helpful and/or interesting but not necessary for professional practice True ___X False ___

d. The ECR use electronic publishers and/or meta-sites on the World Wide Web True ___X False ___

e. The WWW requires knowledge of both ECR and SCR resources True ___ False ___X

There are many resources available to meet each of the above requirements for professional credibility.

Question 48.3: (a) Recognize the need for evidence, know how to search and find relevant information, and assess, utilize, and evaluate the information. To identify best evidence and apply it in the care of the patient, the nurse must apply information literary processes listed above.

Question 48.4: (c) Information literate person is one who can recognize when information is needed and has the ability to locate, evaluate, and use it effectively. While the importance of maintaining currency with published literature is stressed, research has indicated that nurses often do not access the tools needed to do so.

Question 48.5: (d) Tools to implement evidence-based practice, online education and skill-building modules in evidence-based practice, and an online resource center with best EBPs for patients. Research determined that nurses were ready to practice nursing based on EBPs, but need more time, knowledge, skills, access, and a supportive organizational structure.

Question 48.6: (b) Covers required specialty/field, primary journals included, updated regularly, covers appropriate time period, covers materials published internationally, and peer reviewed. The criteria listed above enable nurses to keep abreast of the latest and most evidenced-based information in their selected field.

Question 48.7: (a) BRS, current awareness services, and review services. The essential computer resources for maintaining currency include bibliographic retrieval systems (BRS) for journal literature, current awareness services and review services of the journal literature including point-of-care tools, and currently published books.

Question 48.8: (b) Able to filter and sort vast amount of indexed published material. The CINAHL database, produced by Cinahl Information Services, a division of EBSCO Information Services provided comprehensive coverage of the literature in nursing and allied health from 1982 to the present. More than 4900 journals as well as books, pamphlets, dissertations, and proceedings are indexed. Some journals covered are published in other countries. CINAHL uses a controlled vocabulary for effective subject searching.

Question 48.9: (d) Plan the strategy, break down the search topic into components, check the terms in the subject heading list, select operators, run the search, and view the results. A search of the CINAHL literature enables nurses to answer specific questions that relate to research, practice, and/or education. The six steps outline the methodology to obtain the most reliable and accurate literature with the information needed to solve the nurses' question and/or problem.

Question 48.10: (b) WWW, blogs, chat rooms, and electronic mail. The social media resources listed above are examples of supportive computerized resources. They are similar to the traditional bulletin board where nurses visit to read and participate in the discussion. This format for electronic networking has almost been replaced by forums and newsgroups. The newer social media methods have become a means of collaborating and networking for nurses to build relationships with other professionals concerning issues important to them.

PART 9

Big Data Initiatives

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Genomics and Information Technology for Personalized Health

• OBJECTIVES

1. Explain the basics and current status of genetic and genomics in healthcare so as to understand the continuum of care areas where genomics and Information Technology (IT) are known to facilitate risk identification, diagnosis, and establish prognosis and symptom management.
2. Define why genetics and genomics require Big Data analysis and how it relates to personalized health.
3. Describe the implications for genetic and genomic information for nursing informatics.
4. Identify toolkits that are available in learning about genomics and applying bioinformatics in clinical practice.
5. Understand the ethical, legal, social issues (ELSI) and HHS regulations.
6. Identify genetic and genomic resources that are available for nurses.
7. Summarize the NINR Blueprint for Nursing Research in Genomic Applications.

• KEY WORDS

Genome sequencing
Genetics
Genomics
Comparative genomics
Understanding genome function
Bioinformatics
Big Data and analytics
Human genome and human disease
Nursing applications in genomics
Genomic ethical, legal, and social issues
Translational bioinformatics
Educational competencies

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Why is it important for nurses to understand genetics? Why is important for nurses to understand bioinformatics? Can you define big data? What other industries are interested in big data? Can you describe big data analytic techniques? Why is big data important to healthcare? What is personalized health? What are the implications for healthcare?

For a WIIFM statement, say to the class, "This chapter will provide an update on the intersection between genomics, informatics, and translation of genomics from research into practice." As a nurse, it is important to understand genetics, bioinformatics, big data, and data analytics.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. **Overview**
   - **a.** This is an extraordinary time in healthcare, where genomic discoveries are rapidly being translated into practice to improve health outcomes
     - **(1)** In fact, progress over the last few years has resulted in a transition from genetics, the study of single gene variations into genomics which encompasses all genetic variation coupled with other influences such as the environment and personal factors
     - **(2)** Genomics changes the healthcare implications from what was predominately specialty care associated with rare Mendelian disorders such as Huntington's disease (genetics) into the use of genomic information and technologies as part of the healthcare for common complex conditions such as cancer, heart disease, and diabetes (genomics)
   - **b.** The rapidity in which genomic information is becoming clinically relevant is directly correlated to the reduction in costs of genomic technologies
     - **(1)** Within reach is the capacity to perform whole genome sequencing on an individual for $1000 or less, considered within range of other healthcare expenses facilitating clinical use
     - **(2)** In fact, as of April 2013, the cost for whole genome sequencing had fallen to below $6000, a cost reduction of more than $10,000 in just two years
     - **(3)** Not surprisingly, the capacity to effectively study, store, utilize, and track the rapidly evolving genomic information evidence base is not just a function of preparing the healthcare workforce in the science of genomics, but relies heavily on the design and implementation of the informatics infrastructure needed to support clinical genomic research and translation
   - **c.** The interface between genomics and informatics is extensive and extends into areas beyond traditional discovery and building the evidence base for analytic validity, clinical validity, and clinical utility of genomic information
     - **(1)** For genomic healthcare applications to achieve their optimal benefit, informatics becomes essential to facilitate effective translation into practice such as evidence curation, point-of-care provider decision support, electronic health record (EHR) capacity for data storage and retrieval when indicated, and the ability to establish and track quality metrics on genome technologies and the impact of genomics on health outcomes
     - **(2)** The genomic technology cost reduction and resulting expansion of genomic clinical applications have resulted in a new visioning in the informatics community
     - **(3)** This has resulted in an interface between bioinformatics and clinical informatics termed bio-medical informatics, an essential component of genomic translation
     - **(4)** The importance of this interface is also highlighted in the draft Second Edition of the *Nursing Informatics: Scope and Standards of Practice*, which has included an entire section on genetics and genomics
     - **(5)** This chapter will provide an update on the intersection between genomics, informatics, and translation of genomics from research into practice

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Interface of Genomics in the Healthcare Continuum

1. **Overview**
   - **a.** While oncology has the largest scope of genomic healthcare applications, routine common health conditions are also benefiting from the use of genomic information
     - **(1)** Indeed, genomics influences the entire healthcare continuum beginning before birth through end of life
2. **Preconception and prenatal**
   - **a.** The preconception and prenatal period has an established platform for genomic applications in clinical care
     - **(1)** The American College of Obstetricians and Gynecologists, the American College of Medical Genetics and Genomics, as well as others maintain a series of clinical practice guidelines which cover preconception/prenatal genetic care
     - **(2)** Family history assessment is a critical element for identification of conditions for which clinical practice guidelines exist which may include referral to a genetic specialist and/or further evaluation possibly including genetic testing
     - **(3)** These can include conditions which can impact the health of the mother, for example, thrombophilia; the outcome of the pregnancy, for example, recurrent pregnancy loss or preterm birth; or conditions that can affect the fetus such as cystic fibrosis or neural tube defects
     - **(4)** Even in the absence of a prior history in the family of a given health condition, other indications for referral to genetics that may include genetic testing exist
     - **(5)** These include advanced maternal age where, for example, the risk for fetal chromosomal abnormalities can be increased as well as parents of specific ethnic backgrounds who are at risk for diseases that are more prevalent in that ethnic group, for example, Tay-Sachs and Ashkenazi Jewish heritage
3. **Newborn screening**
   - **a.** Newborn screening (NBS) represents one of the largest public health applications of genomic information
     - **(1)** A dried blood spot obtained from a heel prick of a newborn is used to perform analyses that can help identify

conditions in which early diagnosis could improve outcomes and the harms of population-based screening are outweighed by the benefits

- **(2)** The Discretionary Advisory Committee on Heritable Disorders in Newborns and Children (DACHDNC) provides national guidance about which health conditions should be included as part of NBS
- **(3)** This committee was previously known as the Secretary's Advisory Committee on Heritable Disorders in Newborns and Children
- **(4)** The committee considers several factors in making recommendations as to what disorders should be screened for
- **(5)** These include evidence that screening in the newborn improves health outcomes; screening will cause minimal harm to those unaffected; and the feasibility and readiness of states to implement the screening
- **(6)** Currently the Uniform Screening Panel for NBS includes 31 core disorders and 26 secondary disorders
- **(7)** However, NBS varies across states as individual states can choose which conditions from the Uniform Screening Panel to include and states can also opt to include conditions not recommended as part of the Uniform Screening Panel
- **(8)** For most of the conditions included in the NBS Uniform Screening Panel, abnormal results do not constitute a definitive diagnosis of a condition but serve as a screening tool that requires additional evaluation of the newborn
- **(9)** As such, NBS can produce false positives, false negatives, and ambiguous results

b. In general, NBS is mandatory in most states with specific consent or opt out policies defined by the state

- **(1)** Dried blood spot cards are kept for a minimum of two years but beyond that states can opt to retain the specimens for longer
- **(2)** Retained specimens are being used for quality control purposes, refinement and development of new tests, as well as public health and research purposes
- **(3)** Consent for future use of the dried blood spot also varies by state, with not all states requiring consent for future use
- **(4)** The National Society of Genetic Counselors recently published their position that parents should be educated and informed about the scope of NBS by a qualified healthcare provider and informed about retention of specimens for future use

c. Next steps aimed at expanding and improving NBS include the consideration of next generation genome technologies such as whole genome or exome sequencing

- **(1)** In September 2013, the National Human Genome Research Institute funded several institutions to explore the use of next generation sequencing in the newborn
- **(2)** The ethical, legal, and social issues (ELSI) surrounding the use of these technologies in the newborn is a component of each study funded
- **(3)** The challenges that will be evaluated as part of these studies include management of potential findings, the changing evidence base of genetic variations identified, tracking genetic variations that may not have immediate health implications, the management of incidental findings, and the interface between the public health and clinical care services

4. Disease susceptibility

a. The evidence associated with the genetic basis of an inherited susceptibility to disease has continued to expand with an escalating number of commercially available genetic tests with established analytic validity, clinical validity, and clinical utility

- **(1)** Genetic testing for mutations in genes associated with inherited cancer susceptibility is well established with more than 55 cancer syndromes identified to date
- **(2)** However genetic testing for disease susceptibility is increasingly occurring in other common complex conditions such as heart disease

b. The identification of a germline susceptibility gene mutation is relevant both to individuals diagnosed with a given health condition whose management may be altered as a result of this information, as well as for individuals with no evidence of disease who could benefit from mutation-specific risk management to reduce risk or identify disease early

- **(1)** Additionally, once the genetic basis for a disease is established in a family, based on the gene mutations established Mendelian pattern of transmission, who else in the family is also at risk and should be tested can be readily identified

c. Evidence-based guidelines are available to guide when these tests should be considered

- **(1)** Family history remains a cornerstone of guidelines for consideration of germline genetic testing where early onset disease and multiple affected family members can often be detected
- **(2)** As evidence about inherited susceptibility to disease accumulates, other indicators for testing have emerged such as tumor features

d. Developments in the risk assessment arm of the healthcare continuum include the transition into multiplex testing, which involves testing for mutations in multiple genes in one comprehensive test

- **(1)** This remains controversial given the complexity of the genetic counseling and the interpretation and management decisions based on the findings
- **(2)** However, this is the first step toward a future that involves whole genome or exome analysis that will ultimately become less expensive than single gene or multiple gene testing

5. Screening and diagnosis

a. Genetic information, which may include a genetic test, has long been used to establish and/or confirm a diagnosis of a genetic condition, which can inform therapeutic decision-making

- **(1)** However, expansion of the use of genomic information in the screening and diagnostic arena continue to emerge

- **(2)** An example includes efforts to further increase the specificity of risk calculation models by integrating genomic information such as single nucleotide polymorphisms (SNPs), a common type of genetic variation
- **(3)** SNPs, single DNA base pair changes, can impact risk for diseases as well as metabolism of medications
- **(4)** SNPs are common in the general population so the number of people impacted can be significant
- **(5)** However most SNPs result in risk elevation only slightly above that of the general population (i.e., OR<1.5)
- **(6)** Integrating one or more SNPs into established risk prediction models such as the Breast Cancer Risk Assessment Tool have been studied to determine if the accuracy of the calculation can be increased
- **(7)** However, thus far this work has not achieved evidence of clinical utility
- **(8)** Nonetheless, improving the discriminatory accuracy of established disease risk assessment models as well as developing new risk models using genomic information are important aims and SNP selections as well as large sample sizes for study are critical factors

b. The inclusion of genomic information in screening and/or diagnostic tests has also been gaining momentum

- **(1)** Some of the focus has been on the development of screening and/or diagnostic tests which are sensitive, specific, and less invasive than standard screening tests using molecular markers collected from blood, urine, or stool
- **(2)** Screening for colorectal cancer has been one area of considerable study in part given the challenges associated with adherence to screening colonoscopy in the general population
- **(3)** As technology has advanced, the sensitivity and specificity of this kind of colon screening has progressed to the point where a stool DNA test has been found to detect cancer as well as precursor adenomas with high rates of sensitivity
- **(4)** Larger studies are already underway to evaluate the feasibility, sensitivity, and specificity of this type of test in a screening environment, a necessary step on the pathway to new colorectal screening options

6. Prognosis and therapeutics

a. There are many ways in which genomics is being used to inform prognosis and therapeutics

- **(1)** This is perhaps best illustrated looking at the role of cancer tumor genomic profiling in cancer care
- **(2)** Genetic variation is at the heart of cancer, a disease in which genetic changes are directly associated with the disease
- **(3)** These changes can vary based on disease as well as type of genetic change (i.e., copy number changes, mutations, chromosomal translocation)
- **(4)** Understanding the scope of genetic variation in cancer is informing prognosis, therapeutic decision-making, as well as therapeutic targets
- **(5)** Several large-scale tumor initiatives have helped to inform this field such as The Cancer Genome Atlas (TCGA) that involves in part genomic characterization of specific tumor types; therapeutically applicable research to generate effective treatments (target) which is a similar effort focused on childhood malignancies; and most recently the pan-cancer project which builds on TCGA with further study and analysis of tumor genomes

b. The elucidation of the cancer tumor genome has several clinically relevant applications, some of which have already been translated into practice

- **(1)** First, some inherited cancer syndromes confer cancers, which have distinct tumor phenotypes
- **(2)** Lynch syndrome which is associated with colon, endometrial, ovarian, as well as other cancers is associated with germline mismatch repair gene mutations resulting in evidence of microsatellite instability in colon and endometrial tumors
- **(3)** There are many limitations of family history, for instance provider time and capacity to complete and analyze the history; missing information; and small uninformative families
- **(4)** Additionally, the reliance on traditional family history indicators for consideration of genetic testing may not fully reflect the full spectrum of patients with inherited gene mutations
- **(5)** Therefore, tumor features consistent with a given cancer syndrome, in this case evidence of microsatellite instability, provide a mechanism for identifying patients who would be candidates for further evaluation by genetic specialists

c. Tumor gene expression profiling for different cancers including common malignancies such as breast, colon, and lymphoma have helped to identify prognostic subtypes that extend beyond traditional pathologic and staging criteria which then impact therapeutic decision-making

- **(1)** One very significant use of tumor-specific information is the identification of novel therapeutic targets, which serve as the platform for the development of new targeted treatments
- **(2)** This is perhaps one of the most remarkable areas of growth in cancer care in the past decade with the development of multiple agents for a variety of tumor types (i.e., lung cancer, breast cancer, chronic myeloid leukemia) targeting a vast array of genetic variations

7. Pharmacogenomics

a. Another area of progress in therapeutics is pharmacogenomics

- **(1)** Progress in the genomics of drug metabolism including pharmacodynamics, pharmacokinetics, efficacy, and the illumination of pathway/drug-specific inducers and inhibitors is rapidly progressing
- **(2)** Consider that many people will at some point in their life be prescribed a medication whose dose, inhibitors, and/or inducers, already are or may be in the future, optimized based on genomic information
- **(3)** Pharmacogenomic applications already in practice encompass common health conditions including drugs treating cardiovascular disease, cancer, and infectious diseases

    - **(4)** Currently, the US Food and Drug Administration (FDA) has more than 150 medications that have pharmacogenomic biomarkers included in the drug label
  - **b.** Inhibitors and inducers based on the pharmacogenomics of a drug are also critical and extend the agent's potential contraindications
    - **(1)** Inhibitors decrease or inactivate a specific metabolizing enzyme while inducers do the opposite, increase the enzyme
    - **(2)** Both effects can alter drug metabolism, response, and potential adverse effects

8. **Disease progression and symptom management**
  - **a.** Monitoring for cancer disease progression is a novel and expanding area of genomic application
    - **(1)** In the hematologic malignancies, assays have been developed to measure specific genetic variations that can be indicative of therapy response, resistance, or disease progression
    - **(2)** Research is ongoing evaluating how similar strategies could be applied to the monitoring of patients with solid tumors
  - **b.** Pharmacogenomics has implications in more than one arm of the healthcare continuum
    - **(1)** In this aspect, the area of symptom management is a primary application, use of drugs to manage/treat symptoms of a health condition (i.e., pain control), and the same concepts described above are relevant in terms of efficacy and drug metabolism
    - **(2)** Similarly, the concurrent use of over-the-counter medications, or prescribed medications may serve as inhibitors or inducers of a primary prescribed agent to treat a condition
    - **(3)** A good example to illustrate the importance of this is the over-the-counter herbal supplement St. John's wort used to treat depression, which induces *CYP3A4*
    - **(4)** *CYP3A4* is part of a large family of cytochrome P450 enzymes involved in drug metabolism
    - **(5)** *CYP3A4* is involved in the metabolism of a number of cancer therapeutics, for example, the taxanes

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Informatics, Genomics, and the Healthcare Continuum

1. **Overview**
  - **a.** To realize the benefits of genomics to healthcare outcomes, genomic information has to be effectively translated into practice
    - **(1)** Some of the major challenges associated with the translation of genomics into practice include the availability of clinical practice guidelines which necessitate data derived from large studies; the limited healthcare workforce genomic knowledgebase which will require novel strategies for education given the current fiscal climate; and the infrastructure needed to integrate genomics into healthcare delivery systems such as the EHR and point-of-care decision support
    - **(2)** At the cusp of the $1000 genome, managing the breadth of genomic health information that will continue to evolve over time is a remarkable undertaking, yet it has the opportunity to truly improve and personalize healthcare
    - **(3)** Informatics plays a vital role in every phase of the application of genomics to the healthcare continuum and as such emerges as the keystone of effective genomic clinical translation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Why Genetics and Genomics Require Big Data Analysis

1. **Overview**
  - **a.** Since the last chapter was written in Essentials of Informatics, Version 5, the concepts of genomics and bioinformatics have meshed with the concept of Big Data
    - **(1)** That is because when one adds genomics to the phenotype data of the EHR, and add additional information from laboratory data and tissue repositories, one has petabytes of data for patients with a specific health condition
    - **(2)** Big Data is also considered in need of architecture and platforms that support the insurance industry and pharmaceutical agent development
    - **(3)** This chapter will describe the new concepts in Big Data for personalized health and genomic data
  - **b.** For genomic data to be used in personalized health, molecular pathways involved in disease susceptibility, disease manifestation, and/or progression can be activated by genomic changes described above

Teaching Tip
For example, in cancer, several major tumors have multiple genomic alterations that lead to abnormal proliferation or survival of cells. In order to target the abnormal tissue exactly, pharmaceutical agents are matched to the correct genomic pathway of cell proliferation or survival that has become abnormal.

  - **c.** The technologies used to find out what pathway is abnormal in the genomic profile have been previously described
    - **(1)** The human genome is 3 gigabytes and a laboratory might produce 40 gigabytes of data per day and the technologies for sequencing are producing in any research or laboratory environment about 300 gigabytes per 8 days

2. **Needs of the infrastructure to support personalized care**
  - **a.** Because of the volume of genomic information and clinical data within an EHR and/or Clinical Trials Databases, a blueprint for informatics has been proposed by the Data

and Informatics Working Group (DIWG) to the Director, NIH, to support personalized healthcare

- **(1)** Included in the blueprint are facilities to store data that not only facilitate research and outcomes, but also include the documentation of the clinical care and potential safety issues
- **(2)** First, the systems need to facilitate cross-generational sharing of genomic data from family and laboratory data
- **(3)** Second, the systems should be able to manage, analyze, and interpret the data with decision logic to report to the clinicians and patients making decisions
- **(4)** Third, the system requires a common terminology or taxonomy of terms in both the genomic and clinical and/or research databases
- **(5)** And finally, the formatting of the data storage for exchange with larger groups of people needs to be structured so that it supports queries from multiple sources

3. A nine-step process from patient's genetic/genomics profile to treatment efficacy requiring bioinformatics and informatics support

- **a.** The interaction between the genomic, molecular pathways for a patient, and the specific drug response involves data from multiple sources
  - **(1)** A multistep process is described that has been adapted
  - **(2)** The steps include
    - **i.** The patient encounter
    - **ii.** Imaging data
    - **iii.** Tissue biopsy
    - **iv.** Genomics/molecular/proteomic profiling
    - **v.** Data interpretation after identifying the somatic and germline alterations, listing potentially actionable and consequential variants, and prioritizing events for evaluating response
    - **vi.** Decision support for treatment decision
    - **vii.** Description of the clinical response including the potential toxicities (adverse events and safety) of the treatment management to the patient in addition to outcomes such as a decrease in the tumor response (i.e., treatment effectiveness, clinical condition, survival, exacerbation, or mortality)
    - **viii.** Determination of the tissue to drug management resistance
    - **ix.** Reassessment of a new therapeutic approach
- **b.** Step 5 of the process is the interpretation of what the genomic alteration that might be matched to a specific targeted treatment where the Big Data findings are occurring
  - **(1)** There are multiple public and private databases that require analysis of the genes and pathways involved in the abnormality prior to an actionable treatment course being selected
  - **(2)** Both the clinical actions and the biologic actions need to determine the relevance to the treatment
  - **(3)** These involve heuristic tools, curated and annotated databases, genomic tumor databases, and other knowledgebases that include outcome databases, genomic registries, integrative analysis tools, and machine learning systems
  - **(4)** And in many cases these are several possible treatment alternatives to a particular abnormality
  - **(5)** There may be standard treatments that have known outcomes, clinical trials or experimental therapies, and some with no known clinical or treatment evidence

4. Additional nursing data needs requiring informatics

- **a.** Some additional data generated during this nine-step process include
  - **(1)** Informed consent
  - **(2)** Family history (pedigree)
  - **(3)** Signs and symptoms prior to treatment
  - **(4)** Genetic counseling
  - **(5)** Quality of life
  - **(6)** Pain and functional activities assessment
  - **(7)** Symptom observations such as sleep, fatigue, nausea/vomiting
  - **(8)** Side effect observations such as anemia, bone marrow hypocellular, disseminated intravascular coagulation, febrile neutropenia, hemolysis, hemolytic uremia, leukocytosis, lymph node pain, spleen disorder, thrombotic thrombocytopenic purpura
  - **(9)** Communication management to the patient and the clinical diagnosis and treatment team
- **b.** When patients enter clinical trials where groups of patients' tissues are sequenced and treatment is begun to determine effectiveness, from 100 to 200 patients may be entered into the protocols
  - **(1)** The volume of data in the process and additional data are magnified by 100–200 times
  - **(2)** The types of clinical trials are either adaptive or basket types
- **c.** In adaptive trials, all of the possible treatments matched to the genome are tried
  - **(1)** In the basket type all the patients with a specific gene mutation are given a specific drug, and all the patients with another mutation are given another drug

5. Bioinformatics defined

- **a.** Through all the steps in these processes, informatics tools are the essential component of diagnosis and interpreting data to select patient treatments and measure potential outcomes
  - **(1)** Another way to simplify the understanding of the informatics infrastructure is to look at how we collect, store, access, analyze, exchange data, and integrate research and clinical data to facilitate personalized medicine
  - **(2)** Biomedical informatics has been defined as the "science that develops methods, techniques, and theories regarding how to use data, information and knowledge to support and improve biomedical research, human health, and the delivery of healthcare services"
  - **(3)** In this chapter bioinformatics is separated from healthcare information technology in that bioinformatics

supports the use of computer and databases to analyze genes, genomes, and proteins from varying tissue sources

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Toolkits that Are Available in Learning about Genomics and Applying Bioinformatics in Clinical Practice

1. Overview
    - **a.** In a 2012 report of the Institute of Medicine, where bioinformatics tools going forward were described, the panel recommended
        - **(1)** Utilizing standardized, open source data bases with professional annotation, analytics, and curations
        - **(2)** Integrating research and clinical data
        - **(3)** Supporting open source platforms for the development of software
        - **(4)** Considering secondary uses of IT infrastructure as a way to reduce overall costs
    - **b.** The process of personalized health is often called clinical translational research process when the benefits of research are translated into clinical practice
        - **(1)** The IOM panel in 2012 recommended
            - **i.** Standardizing clinical data similar to high-quality research data
            - **ii.** Developing new statistical methods and study designs for use with clinical trials
            - **iii.** Developing better data mining and filtering approaches to sort through massive datasets
            - **iv.** Connecting genomic and molecular data with clinical data
            - **v.** Structuring clinical data to support the research data
            - **vi.** Integrating data that are already in the public domain to generate new hypotheses for testing
            - **vii.** Ensuring processes are guided with a research framework
            - **viii.** Using a systems view of disease, which postulates that disease is a result of perturbations of one or more biological networks that lead to altered expressions of information
2. **Managing the large volume and scale**
    - **a.** The large volume and data and scale is a result of a dynamic environment where discoveries are occurring with incredible speed, patient populations are more dynamic and even global, and patients may come with preexisting conditions that require subgroup analysis, and the ability to data mine large amounts of data
        - **(1)** In addition many areas are using open source networks and multiple communities
        - **(2)** One new model is for groups to utilize the advances of cloud computing in bioinformatics
    - **b.** Cloud computing is a model that increases the storage, computation, and collaboration capacity in personalized health while reducing the time needed for data mapping and analysis
        - **(1)** The cloud can be a shared resource that can be accessed over the Internet to do the complex integration of databases and analysis tools to make informed interpretations of the data
        - **(2)** NIST provides guidance on assuring cloud storage security and authentication similar to any other large database
        - **(3)** Further research is needed to identify security, reliability of using clouds, handling and sharing intellectual property on clouds, and maintaining regulatory compliance
3. **What is the hoopla about HADOOP?**
    - **a.** Apache Hadoop is a large scale open source distributed processing framework platform that allows big data to be brought into existing data warehouses
        - **(1)** The architectural framework allows data management, and analytics for processing, storage, and using data. It is the data processing that has worked well in large Web-based enterprises as Google and Yahoo
        - **(2)** It can be used to move large scale data to a cloud. Associated with it have been related technologies such as Hive, Hadapt, Impala, Sqrrl, HBase, Know, and Pig
        - **(3)** Recently released was YARN (yet another resource negotiator) with version 2
        - **(4)** Users are describing it as a new style of programming that is helpful in this big data environment
4. **Public databases available**
    - **a.** With the vast number of siloed databases from molecular, clinical, and epidemiological data that already resides in databases, one can quickly visualize that an integrated data warehouse or repository in the public domain can allow not only for
        - **(1)** Hypothesis-driven studies, but also to
        - **(2)** Hypothesis-generated diagnosis and treatment
        - **(3)** Potential regimes that allow for discovery of new hypothesis of potential diagnostic biomarkers
        - **(4)** Treatment regimes matched to improve health
    - **b.** One of the large data repositories is the National Center for Biotechnology Information (NCBI) Gene Expression Omnibus (GEO)
        - **(1)** This repository holds more than 1 million publicly available microarray datasets and support MIAME standards
        - **(2)** Another repository called COSMIC (Catalogue of Somatic Mutations in Cancer) is a European repository with more than 1 million somatic mutations identified for human cancers
        - **(3)** Data and consultation can also be purchased from Assay Depot, an online marketplace for scientific and pharmaceutical research services
        - **(4)** This includes the purchase of assays, animal models, and services from vendors

- **c.** The Broad Institute developed a Connectivity Map (cmap) that is a repository of genome wide transcriptional expression data from human cell lines created with responses from different drugs at varying doses
    - **(1)** It currently includes 7000 expression profiles representing 1309 compounds
    - **(2)** This links the gene expression data with the drug gene expression data
    - **(3)** Discovery lies within these databanks

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

A Case for Integration into Nursing Informatics

1. **Overview**
    - **a.** In modern Healthcare Information Technology most of the data currently exist in silos and the analysis and interpretation require the integration of data from various systems, or access to data in distributed systems
        - **(1)** Integrated data is more accessible and available to broader networks through exchanges
        - **(2)** The data are definitely decentralized, but the analytics and decision support and interpretation require centrality of data, and accessibility at the point-of-care
        - **(3)** The transition from siloed data to integrated data requires standards in data and validity assurance of data, normalization of data (or data cleansing), and policies of data sharing
        - **(4)** In order for data to be analyzed, the integration of clinical and genomic data requires that data quality start at the point-of-care
2. **Managing the standards**
    - **a.** There are many areas where standards are needed in developing the biomedical informatics supports for personalized health
        - **(1)** Inherent in the collection of data from disparate databases is the theoretical framework of the data, and adherence to standardized terminology in order to make the systems and data interoperable
        - **(2)** Currently under discussion related to standards, are the standards to describe how the genomic data are being collected
        - **(3)** In another Institute of Medicine Report on Precision Medicine, the panel recommended standards in genetic and genomic terminology
        - **(4)** Without it and the standards in clinical medicine, the integration of multiple databases will not result in meaningful interpretation
        - **(5)** The precision of standards requires a considerable commitment to data harmonization and curation
3. **Validating data for analysis in bioinformatics**
    - **a.** A cautionary message is coming from the research scientists and the public genetic industry that not all data stored in databases from academic and public labs can be replicated by industry for new drug target validation prior to submission to the FDA
        - **(1)** It is because of these discrepancies that the FDA is reviewing validation issues for the clinical use of genome sequencing
4. **Data sharing**
    - **a.** To translate patient care information into discovery and positive outcomes of patient care requires data from multiple sources
        - **(1)** The value of data sharing is that the best practices of diagnosis and treatment can be leveraged to many patients with a condition and to many healthcare providers
        - **(2)** Data come from EHRs, doctors' and other healthcare providers' office and clinic records, personal health records from patients, research center data and networks, genomic and annotation services, and the patients themselves
    - **b.** Policies and procedures for sharing these data are required
        - **(1)** Governance policies and structures need to be put into the enterprise architectures
        - **(2)** Since the patients need to be available for a lifetime, their data need to be used and reused by many people, and treatments may change in the future that better match the patient being seen today, a static one time informed consent may be obsolete
        - **(3)** As we look at more breaches occurring to our privacy and security in the financial sector, our most valuable asset of identity and health is our genetic structure
        - **(4)** New cybersecurity infrastructures will have to be developed with new types of algorithms to encrypt data
5. **No better advocate for personalized health than the consumer/patient**
    - **a.** Consumers are more informed, use more common databases, and utilize more social networks in genetics, diagnosis, treatment, and outcomes
        - **(1)** A significant amount of traffic on government Web sites involves patients
        - **(2)** Because so many of the tools and databases are Web-based, and the consumers have so much access to open information, they have the potential of being the biggest disruptive innovators
        - **(3)** The consumer is also using mobile technology through telecommunications networks to access these databases
        - **(4)** It is the patient/consumer who is knowledgeable about what is available, who has the potential to drive the implementation of genomics into healthcare
6. **Moving to the future in bioinformatics**
    - **a.** Models of the next generation health IT system are able to comprehensively capture the genetic, genomic, biological, behavioral, social, environmental, and ecological factors relevant to disease susceptibility, risk, progression, and outcome of treatments
        - **(1)** The look to the future reinforces that the systems we build today must be standardized and include validated data

- **(2)** Big data in the future will require new types of visualization and summary data that can be integrated into routine clinical care by multiple healthcare professionals
- **(3)** There will be new requirements for certifications in bioinformatics to prepare the kind of workforce needed for this expanding area of clinical practice and scientific research
- **(4)** There are models throughout the country that have supported research to link clinical and research data
- **(5)** We are learning from their innovations and move forward with optimism toward the totally integrated bioinformatics system in the future

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Ethical, Legal, and Social Issues

1. Overview
   - **a.** As genomic discoveries continued to translate into clinical practice, there are several ELSI that emerge including regulation of genetic and genomic tests, and other incidental findings
     - **(1)** A brief description of each area follows
2. **Regulation of genetic and genomic tests**
   - **a.** The regulations associated with genetic testing have not kept pace with the current environment
     - **(1)** As such discoveries in the laboratory can progress directly to clinical testing including directly to consumer marketing and/or testing despite insufficient evidence of analytic and clinical validity
     - **(2)** To address this gap, the Center for Disease Control (CDC) Office of Public Health Genomics established the Evaluation of Genomic Applications in Practice and Prevention (EGAPP), which conducts systematic evidence reviews on the validity and utility of genetic tests
     - **(3)** Unfortunately, the evidence reports have not been able to keep pace with the genetic tests that are being introduced clinically
   - **b.** There are also gaps in regulating the laboratories themselves
     - **(1)** The Clinical Laboratory Improvement Act (CLIA) designates qualifications of laboratory personnel, standards for quality assurance, and documentation of tests and procedures for tests that produce clinical information
     - **(2)** Genetic and genomic tests are classified as high complexity tests and as such CLIA mandates laboratory proficiency testing to confirm a laboratory's capacity to perform and interpret these tests
     - **(3)** To date proficiency laboratory evaluations for genetic and genomic tests are not mandated by CLIA
     - **(4)** Furthermore, proficiency testing for the continued development of new testing techniques is still required
   - **c.** Another avenue of regulation of genetic and genomic tests is through the FDA
     - **(1)** Test kits produced for use by more than one laboratory are regulated by the FDA
     - **(2)** However, most genetic and genomic tests are developed within individual laboratories, are not marketed to other laboratories as a kit, and as such fall outside the oversight of the FDA
     - **(3)** This represents the majority of genetic and genomic tests currently available
     - **(4)** Related to this regulatory gap, direct to consumer genetic and genomic tests that provide medical as well as other information but require no healthcare provider input or oversight prior to ordering the test have been developed and sold directly to the consumer
     - **(5)** As this market has continued to expand and expert panels called for additional oversight, the FDA in 2010 initiated a series of reviews and actions aimed at the genetic and genomic laboratory developed testing regulatory environment
   - **d.** In the intervening period while the gaps in regulations are being addressed, the healthcare provider must assume the responsibility for not just when to consider a genetic or genomic test and what test to order now that multiplex testing is available, but selecting the laboratory that is capable of performing the test
     - **(1)** To address this challenge, the CDC developed a framework (Office of Surveillance) for assessing analytic and clinical validity, clinical utility, and ethical, legal, and social implications of genetic and genomic tests

Teaching Tip
See Figure 49.2 for an overview of the elements of the ACCE Model.

     - **(2)** ACCE does not incorporate personal utility into the model which is associated with potential indirect outcomes of testing such as understanding of genetics of a given disease and the influence of this information on personal decision-making
   - **e.** Additionally, the National Institutes of Health has established the Genetic Testing Registry, which is a voluntary detailed listing of genetic tests available from the laboratories performing those tests as well as details about test techniques, ordering, and performance
     - **(1)** As the complexity and volume of genetic and genomic tests continue to expand, provider decision support tools will continue to play an important role in the translation of this into routine clinical practice
3. **Incidental findings**
   - **a.** As the cost for whole genome analysis continues to decline, the application of these technologies in clinical and research settings continues to expand
     - **(1)** With that comes the reality of how to best handle incidental findings
     - **(2)** Incidental findings are defined as, "A finding concerning an individual research participant that has potential

health or reproductive importance and is discovered in the course of conducting research but is beyond the aims of the study"

- **(3)** This is not a phenomena unique to genomics but has long been a component of healthcare
- **(4)** However, the sheer scope of the potential findings and the ever-changing evidence base of what meets the criteria for a clinically actionable finding create several challenges resulting in an ongoing debate in the literature about how best to address this in both clinical and research settings

b. Existing laws and federal regulations for human subjects research inadequate to no guidance and thus far legal cases have yet to emerge

- **(1)** Consider the following, 45 CFR 46 Protection of Human Subjects 46.102 states "*Human subject* means a living individual about whom an investigator (whether professional or student) conducting research obtains
  - **i.** Data through intervention or interaction with the individual
  - **ii.** Identifiable private information"
- **(2)** Yet identification through research analysis performed after death that reveals a germline mutation in which there is well-established analytic and clinical validity as well as clinical utility (i.e., *BRCA1* or *BRCA*2 mutation associated with breast, ovarian, and other cancers) does have implications for living family members
- **(3)** As such, this discovery meets the criteria for an incidental finding
- **(4)** But what finding actually meets the threshold for meeting analytic and clinical validity as well as clinical utility standards?
- **(5)** Several groups have grappled with this challenge
- **(6)** The National Heart, Lung, and Blood Institute (NHLBI) Working Group on Reporting Genetic Results in Research Studies developed and then updated their recommendations which specify the following criteria
  - "The genetic finding has important health implications for the participant, and the associated risks are established and substantial
  - The genetic finding is actionable, that is, there are established therapeutic or preventive interventions or other available actions that have the potential to change the clinical course of the disease
  - The test is analytically valid, and the disclosure plan complies with all applicable laws
  - During the informed consent process or subsequently, the study participant has opted to receive his or her individual genetic results"

c. In 2013, the American College of Medical Genetics and Genomics (ACMG) published their policy statement on reporting of incidental findings from clinical exome and genome sequencing

- **(1)** An important distinction between these two statements is that the ACMG policy statement is specific to clinical application of these technologies whereas the criteria established by NHLBI refers to research use of these technologies
- **(2)** ACMG specifically reviewed the existing evidence and specify that laboratories should interrogate the genome for a list of specific genes associated with specific phenotype/syndromes
- **(3)** This differs from classic incidental findings, which do not involve deliberate interrogation of the genome for abnormalities
- **(4)** The selection of conditions included in ACMG list was based on high prevalence and where interventions exist
- **(5)** Additionally, in contrast to NHLBI which defers to the patient agreeing to receive this information at the time of consent, ACMG's position is that the duty to warn surpasses patient autonomy and that the decision to disclose these results should not be restricted to the age of majority but encompass disclosure of results including adult onset disorders to the parents of children

d. As the genetic healthcare community has continued to grapple with how best to address the challenge of incidental findings, the Presidential Commission on the Study of Bioethical Issues also looked closely at this issue and published their report in December 2013

- **(1)** The Commission made several recommendations that can be classified into five major areas
  - Communication of results: Individuals should be provided with information about the potential for incidental findings and the methods that will be used for notification
  - Evidence-based guideline development: Professional organizations should strive to develop evidence-based guidelines for the management of potential findings from these techniques
  - Expand the evidence base: Funding agencies should continue to offer funding for research focused on incidental findings encompassing everything from discovery to disclosure considerations
  - Education: Education materials need to be developed for all key stakeholders, including healthcare providers, institutional review boards, and potential recipients of this information, that cover ethical, practical, and legal issues associated with incidental findings
  - Justice and fairness: All persons would have access to the information, guidance, and support required to make informed decisions about testing and management of outcomes

e. The intersection of informatics and challenge of managing incidental findings is clearly evident

- **(1)** First are the effective strategies for interrogating the genome, identifying and classifying the variations identified into buckets associated with clinical relevance, and tracking evidence changes that effect classification
- **(2)** Second is the need for a healthcare infrastructure that has the capacity to effectively integrate this information into workflow informatics systems such as the EHR

(3) Third is the infrastructure to track individual genomic information as an individual moves through the healthcare continuum from birth to death and pull in the relevant information to guide healthcare when needed

Teaching Tip
For example, when a child is found to harbor a genetic predisposition to an adult onset disorder that would necessitate a change in management beginning at a particular age. Additionally, novel strategies for healthcare provider education in genomics and point-of-care decision support are critical.

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Educational Resources for Nursing in Genomics and Informatics

1. **Overview**

Teaching Tip
Table 49.1 provides additional educational resources for nursing in genomics and informatics.

a. Students reading this chapter should understand that the science of genetics and genomics and bioinformatics are evolving so fast that there are many sites to constantly monitor

- **(1)** Another useful reference is McCormick (2011) that cites many learning resources
- **(2)** Another excellent resource is *The Journal of Nursing Scholarship Genomic Nursing Webinar Series* 2013 Genomics Special Issue
- **(3)** Several authors describe the special issue and the importance in the delivery of care by all healthcare professionals, including nurses in every healthcare setting
- **(4)** Another resource with many Webinars and educational resources, including recommendations of curricula for genetic competencies is Genome.gov

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

The Blueprint for Genomic Nursing Science

1. **Overview**

a. In 2012, the National Institutes of Health convened an interdisciplinary panel to establish a Blueprint for genomic nursing science that could be used to focus research efforts to fill identified evidence gaps

- **(1)** The panel consisted of multiple government agencies, genomic experts, and representatives from key stakeholder groups
- **(2)** The Blueprint was established though an analysis of existing evidence, expert evaluation of the current state of the science, and then solicitation from the public for comments on the draft document, which were then incorporated into the final Blueprint

b. The Blueprint (Table 49.2) is mapped to the major focus areas of the National Institutes of Nursing Research Strategic Plan: health promotion and disease prevention; advancing the quality of life; innovation; and training

- **(1)** Cross-cutting themes that need to be considered with any of the research priorities included in the Blueprint were health disparities, cost, policy, and public education
- **(2)** The Blueprint focuses on two primary areas: the client, defined broadly as person, family, community, and/or population; and the context, which encompasses capacity building and informatics infrastructure support

c. Informatics figures prominently throughout the Blueprint

- **(1)** As discussed above, to address many of the client-based research priorities described in the Blueprint, large studies relying on massive data warehouses and big data analytics and interpretation are needed
- **(2)** Discoveries that are found to have clinical utility will be translated into practice more readily with informatics that facilitates work flow such as collection of documentation and interpretation of genomic information (i.e., family history); ease of test selection and ordering; point-of-care decision support; and capacity to store, track, and retrieve genomic information while maintaining patient privacy in the EHR

d. Consider a specific example, pharmacogenomics, to elucidate the interface between informatics and the Blueprint

- **(1)** Pharmacogenomics is the use of genomic variation (inherited and acquired) in drug development and drug response including selection, efficacy, pharmacokinetics, pharmacodynamics, and toxicity
- **(2)** Drugs are used throughout the healthcare continuum, not just to treat common complex health disorders but also to reduce risk (i.e., chemoprevention) and ameliorate symptoms (i.e., pain control)
- **(3)** Biologic plausibility studies, which increasingly are performed using big data, can encompass genomic pathway identification, which can identify targets for pharmaceuticals interventions, which are then followed by phenotype/drug-specific response assessments again relying heavily on informatics
- **(4)** Once the data is sufficient to establish analytic validity, and clinical validity and utility, translation into practice begins
- **(5)** To facilitate pharmacogenomic translation, the capacity of the healthcare workforce in genomics needs to be expanded
- **(6)** In this era of cost containment, online education interventions are critical, but that is not sufficient

e. Outcome assessments from any capacity building initiative must be incorporated as preliminary evidence indicates that traditional methods of continuing healthcare provider education may be insufficient given the complexity of this information

  (1) Given the broad diversity, size, and interprofessional nature of the practicing healthcare workforce, most of which have no foundation in genomics, this is an especially complex undertaking

f. As translation penetrates the practice environment, development of useful point-of-care decision support as drug selection is being considered

  (1) Some of these decisions needed at the point-of-care may include

    i. For a given agent, should a genetic test be considered

    ii. If so, what test

    iii. Where in the EHR can you readily access whether this has been performed before and

    iv. If so, how do you retrieve those results

    v. If not performed before, how to order the test, retrieve the results

    vi. How to use that information to inform drug selection, dosing

    vii. Whether any of the patients existing medications serve as a genomic pathway inhibitor and inducer

g. Given the rapidly evolving complexity and evidence base of pharmacogenomics, and the overlap of specific genetic variations with a wide range of drugs, informatics support systems become paramount

  (1) To develop these infrastructures, informatics policies that assure patient privacy to minimize harm need to be established

  (2) Then comes one of the last phases of this example, the cost/benefit analysis and if benefits outweigh the costs, establishment of the infrastructure needed to assess quality indicators to assure patient outcomes is optimized

h. Nursing research in genomics will help establish the evidence base needed to facilitate translation of genomics into practice to improve health outcomes

  (1) The Blueprint for Genomic Nursing Science provides the platform to accelerate nursing research addressing identified critical gaps

  (2) The science outlined in the Blueprint intersects with informatics on two primary platforms, research performed utilizing informatics, and research to develop informatics support systems needed to facilitate genomic translation

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

- Advancing technology and new knowledge about genomics underlies an increasing component of healthcare and has influences on the entire wellness to illness continuum
- Therefore, genomics impacts the entire healthcare workforce and the translation of those discoveries into healthcare is rapidly progressing
- Informatics plays a central role in the evidence generation and capacity building for translation into practice to realize the benefits of genomics

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Explain the basics and current status of genetic and genomics in healthcare so as to understand the continuum of care areas where genomics and Information Technology (IT) are known to facilitate risk identification, diagnosis, and establish prognosis and symptom management
- Define why genetics and genomics require Big Data Analysis and how it relates to personalized health
- Describe the implications for genetic and genomic information for nursing informatics
- Identify toolkits that are available in learning about genomics and applying bioinformatics in clinical practice
- Understand the ethical, legal, social issues (ELSI) and HHS regulations
- Identify genetic and genomic resources that are available for nurses
- Summarize the NINR Blueprint for nursing research in genomic applications

Teaching Tip
Ask the students to define the keywords

- Genome sequencing
- Genetics
- Genomics
- Comparative genomics
- Understanding genome function
- Bioinformatics
- Big Data and analytics
- Human genome and human disease
- Nursing applications in genomics
- Genomic ethical, legal, and social issues
- Translational bioinformatics
- Educational competencies

CHAPTER REVIEW QUESTIONS

Question 49.1: The importance of genomics in healthcare is:

- **a.** To understand the genetics in healthcare
- **b.** To facilitate risk identification, diagnosis, and establish prognosis and symptom management
- **c.** To plan for the future of healthcare
- **d.** To understand the actions of each gene

Question 49.2: Why does genetic and genomic information require big data storage and analytics?

- **a.** The content of each person is big
- **b.** State and national healthcare data are needed
- **c.** It is costly to pay for the data
- **d.** The diagnosis and analysis due to genomics require the integration of several large databases, oftentimes requiring cloud computing

Question 49.3: What are the implications of genomics with nursing informatics?

- **a.** There are no implications of genomics, it is purely a biologic science
- **b.** The implications are addressed in the new ANA Professional Standards for Nursing Informatics—since it covers the continuum of care
- **c.** The implications are for the interfacing of diagnostic tools into the personal health record
- **d.** The implications are more for pharmacists than for nurses

Question 49.4: What part of the continuum of care is affected by genetics and genomics?

- **a.** None of the parts of continuum of care are affected
- **b.** The continuum of care from preconception to death
- **c.** The continuum of care from a diagnosis to death
- **d.** The continuum of care from diagnosis to treatment

Question 49.5: Which healthcare conditions are affected by genetics and genomics?

- **a.** Only autism is affected
- **b.** Relatively few healthcare conditions are affected
- **c.** All cancers, immunological, neurological, and cardiovascular conditions are affected by genetics and genomics
- **d.** Only cancer is a genetic disease

Question 49.6: Name one public database for data on genetics and genomics.

- **a.** The public database for genetics and genomics such as GEO and MIAME are available from NCBI
- **b.** There are no public databases because of the confidentiality and privacy laws
- **c.** The databases cannot be shared because of HIPAA rules
- **d.** The databases cannot be made public because of international sharing rules

Question 49.7: What does ELSI stand for?

- **a.** Education in laws for standards in informatics
- **b.** Equality of laws for standard genomic interpretations
- **c.** Ethical, legal, and social issues related to genetics and genomics
- **d.** Efficiencies in leveraging standards in healthcare

Question 49.8: What is an incidental finding?

- **a.** A finding concerning an individual research participant that has potential health or reproductive importance and is discovered in the course of conducting research but is beyond the aims of the study
- **a.** An incidental finding has nothing to do with genetics and genomics
- **c.** It is a finding of paternity
- **d.** It is a finding that indicates how an individual responds to diagnostic tools

Question 49.9: Do genetic and genomic competencies exist for nursing education?

- **a.** Although important, no genetic and genomic competencies have been developed for nursing
- **b.** Genetic and genomic competencies are being planned by AAN
- **c.** Genetic and genomic competencies are in their second edition and developed by consensus of many professional organizations
- **d.** It is too early to develop competencies for this evolving science

Question 49.10: Does the NINR Blueprint include recommendations for including genetics and genomics in nursing research?

- **a.** No, it is too early in the science to recommend research
- **b.** Yes, the NINR Blueprint includes recommendations
- **c.** All of the diagnostic institutes of NIH cover research, but NINR does not at this time
- **d.** The NINR has plans to include recommendations

ANSWERS AND EXPLANATIONS

Question 49.1: (b) The importance of genomics in healthcare is to facilitate risk identification, diagnosis, and establish prognosis and symptom management.

Question 49.2: (d) The diagnosis and analysis due to genomics require the integration of several large databases. There are multiple public and private databases that require analysis of the genes and pathways involved in the abnormality prior to an actionable treatment course being selected. Both the clinical actions and the biologic actions need to determine the relevance to the treatment. These involve heuristic tools, curated and annotated databases, genomic tumor databases, and other knowledgebases that include outcome databases, genomic registries, integrative analysis tools, and machine learning systems. And in many cases these are several possible treatment alternatives to a particular abnormality.

Question 49.3: (b) The implications are addressed in the new ANA Professional Standards for Nursing Informatics—since it covers the continuum of care.

Question 49.4: (b) The entire continuum of care from preconception to death is affected by genetics and genomics.

Question 49.5: (c) All cancers, immunological, neurological, and cardiovascular conditions are affected by genetics and genomics.

Question 49.6: (a) There are many public databases. GEO and MIAME are available from NCBI.

Question 49.7: (c) Ethical, legal, and social issues related to genetics and genomics.

Question 49.8: (a) "A finding concerning an individual research participant that has potential health or reproductive importance and is discovered in the course of conducting research but is beyond the aims of the study."

Question 49.9: (c) Genetic and genomic competencies are in their second edition and developed by consensus of many professional organizations.

Question 49.10: (b) Yes, the NINR Blueprint includes recommendations.

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Global eHealth and Informatics

• OBJECTIVES

1. Describe international organizations and their roles in advancing global eHealth and informatics.
2. Discuss nursing's contributions to international health informatics initiatives.
3. Discuss applications of eHealth in the global health environment.
4. Explore current issues and trends for their effects on global eHealth and nursing.

• KEY WORDS

eHealth
Global health
mHealth
Nursing informatics
Telehealth nursing

Estimated Time for Module: 1 hour

INTRODUCTION

Gain Attention

1. Common ground
2. WIIFM (what's in it for me) statement to generate interest in the topic

Instructor Tip

When gaining attention and establishing common ground, ask questions of the class, such as the following: Is health global? How would you define global health? Why is it important for nurses to belong to international organizations? Can you give an example of an international nursing organization? What is telehealth? Can you provide an example?

For a WIIFM statement, say to the class, "The purpose of this chapter is to inform nurses about international eHealth initiatives and to describe the influence of nurses on these initiatives as well as how these initiatives will continue to influence the profession of nursing. eHealth policy and applications can be influenced by nurses in care delivery, education, administration, and research. This chapter includes a description of the roles of international health organizations in global eHealth and informatics, a discussion of eHealth applications in the global health environment with particular emphasis on the relevance to nursing, and an exploration of healthcare issues and trends in relation to global eHealth and nurses worldwide." As a nurse, it is important to understand international health initiatives as well as international health organizations.

Class Preparation

1. Review the references and Web site listed at the end of the chapter in the textbook
2. Encourage students to visit Internet Web sites relevant to the chapter

Timing

1. Lecture: 60 minutes

PRETEST

1. No pretest for this chapter

CHAPTER OUTLINE

Introduction

1. Overview
   a. Nurses are major stakeholder in the global healthcare community
      (1) As a profession, nursing has championed and contributed to a number of international health informatics and eHealth initiatives
      (2) While nursing and healthcare informatics are often described as sciences in the literature eHealth is generally defined as a set of activities, processes, or means for the delivery of health services using information and communication technologies (ICT) at both the macro and the micro levels

(3) More specifically, eHealth is defined as the use of ICT for health

Teaching Tip

Examples include using ICT for treating patients, conducting research, educating the health workforce, tracking diseases, and monitoring public health.

b. eHealth has been further described by the World Health Organization (WHO) as the transfer of health resources and healthcare by electronic means, encompassing three main areas

(1) The delivery of health information, for health professionals and health consumers, through the Internet and telecommunications

(2) Using the power of IT and e-commerce to improve public health services, for example, through the education and training of health workers

(3) The use of e-commerce and e-business practices in health systems management

c. The purpose of this chapter is to inform nurses about international eHealth initiatives and to describe the influence of nurses on these initiatives as well as how these initiatives will continue to influence the profession of nursing

(1) eHealth policy and applications can be influenced by nurses in care delivery, education, administration, and research

(2) This chapter includes a description of the roles of international health organizations in global eHealth and informatics, a discussion of eHealth applications in the global health environment with particular emphasis on the relevance to nursing, and an exploration of healthcare issues and trends in relation to global eHealth and nurses worldwide

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

International Organizations Influencing eHealth and Nursing

1. Overview

a. With advances in healthcare technology, international health-related organizations have focused their efforts on exploiting the potential of eHealth for improvements in healthcare delivery and infrastructure

(1) New programs and organizations are being established to respond to the development and growth of eHealth policy and applications internationally

2. **International Council of Nurses (ICN)**

a. Founded in 1899, the ICN is the world's first and widest reaching international organization for health professionals

(1) ICN is a federation of more than 130 national nurses associations, and represents more than 16 million nurses worldwide

(2) The three goals of the ICN are to bring nursing together worldwide, to advance nurses and nursing, and to influence health policy

(3) The ICN is involved in initiatives related to professional nursing practice, nursing regulation, and socioeconomic welfare for nurses

(4) ICN promotes quality nursing care for all, with and through a competent and satisfied nursing workforce

(5) ICN supports the advancement of experiential- and research-based nursing knowledge, which are hallmarks of a respected nursing profession

b. ICN represents the profession of nursing in a number of international venues, including the United Nations, WHO, the World Health Professions Alliance, and other organizations discussed below

(1) As the international voice for nursing, ICN recently added a new program with a focus on eHealth

3. **ICN eHealth Program**

a. The ICN eHealth Program was launched in 2011 in response to the growing needs for professional participation in eHealth policies at the national and international level

(1) The ICN eHealth Program encompasses three major initiatives

i. *International Classification for Nursing Practice* (ICNP®), which is a terminology for nursing that provides an international standard for facilitating the description and comparison of nursing practice locally, regionally, nationally, and internationally

ii. *ICN Telenursing Network*, which aims to involve and support nurses in the development and application of telehealth technologies

iii. *Connecting Nurses* initiative, which provides an online forum for nurses worldwide to share ideas, advice, and innovations

iv. Explore and support initiatives and programs internal to ICN adding ICT knowledge and capabilities as appropriate

b. The ICN eHealth Program is based on the understanding that the visionary application of ICT can transform nursing and healthcare

(1) The Program aims to support eHealth practice, to be recognized as an authority on eHealth, and to position nurses as experts in the eHealth international community

4. **World Health Organization**

a. The WHO is the authority for directing and coordinating health within the United Nations system

(1) WHO provides leadership on global health matters such as shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries, and monitoring and assessing health trends

b. Each year, WHO holds the World Health Assembly (WHA) in Geneva, Switzerland

(1) The WHA is the decision-making body of WHO. ICN is a member of WHO, representing the profession of nursing

(2) This past year (2013), eHealth was on the WHA agenda

(3) A resolution (WHA66.24) on eHealth standardization and interoperability was approved and the importance

of health data standardization as part of health systems and services was noted

5. **World Health Organization Family of International Classifications (WHO FIC)**
   - **a.** WHO has long maintained and used the International Classification of Diseases (ICD) for national and international reporting of morbidity and mortality statistics. In addition to ICD, WHO has developed the International Classification of Functioning (ICF) for documentation and reporting of functional abilities and health
     - **(1)** A new endeavor under the leadership of WHO FIC is the development of the International Classification of Health Interventions (ICHI) which is a classification of interventions for use across all health professions
6. **International Medical Informatics Association (IMIA)**
   - **a.** Established in 1989, the IMIA is an independent, nongovernmental organization made up of national medical informatics associations, institutional (Academic and Corporate) and Affiliate Members, and Honorary Fellows
     - **(1)** IMIA plays a global role in the application of information science and technology in the fields of health and biomedical informatics
7. **International Medical Informatics Association-Nursing Informatics Special Interest Group (IMIA-SIG)**
   - **a.** IMIA has a Special Interest Group (SIG) that focuses on nursing informatics. Membership includes over 25 society (formerly country) representatives and several observer members
     - **(1)** The SIG meets regularly at related informatics conferences
     - **(2)** IMIA-NI aims to foster collaboration among nurses and other healthcare professionals to advance the development of nursing informatics
     - **(3)** The Nursing Informatics SIG hosts an international conference every two years to promote the dissemination of new knowledge and research in the field of nursing informatics
8. **International Organization for Standardization (ISO)**
   - **a.** The ISO is the world's largest developer of voluntary international standards
     - **(1)** ISO standards provide state-of-the art specifications for products, services, and best practices, in an effort to make industry more efficient and effective
     - **(2)** ISO was founded in 1947, and since then has published more than 19,500 standards and reports that address almost all aspects of technology and business, including health
9. **ISO Technical Committee 215: Healthcare Informatics**
   - **a.** ISO Technical Committee (TC) 215 for Healthcare Informatics has as its scope the standardization of health information resources, including health ICT
     - **(1)** The aim of the Committee is to promote interoperability between independent systems, to enable compatibility and consistency of health information and data, and to reduce duplication of effort and redundancy
   - **b.** ISO TC 215 is also the body that is responsible for new standards that involve nursing informatics and telehealth nursing in the areas of terminology, telehealth, messaging, and a range of other topics related to eHealth
     - **(1)** ISO TCs are composed of a set of different countries' Technical Advisory Groups (TAGs)
     - **(2)** The TAGs for TC 215 include individuals from standards development organizations, professional, governmental or commercial organizations, as well as individuals representing themselves
   - **c.** The recent approval of the new International Standard 18104 (Health Informatics, Categorical structures for representation of nursing diagnoses and nursing actions in terminological systems) is an example of a nursing-specific standard formalized by ISO
     - **(1)** The new standard replaced ISO 18104:2003 Health Informatics—Integration of a Reference Terminology for Nursing
     - **(2)** The purpose of Standard 18104 is to promote interoperability in healthcare systems
     - **(3)** This ISO standard has been used to evaluate and support ongoing develop of nursing terminologies, especially in supporting the definition of high-level schemata in developing logic-based compositional terminologies such as ICNP
10. **International Health Terminology Standards Development Organization (IHTSDO)**
    - **a.** The IHTSDO is a not-for-profit organization based in Denmark
      - **(1)** Its main purpose is to develop and maintain the Systematized *Nomenclature of Medicine—Clinical Terms* (SNOMED CT)
      - **(2)** SNOMED CT applications serve as an international, interdisciplinary healthcare terminology. The organization focuses on supporting the implementation of interoperable, semantically accurate health record documentation
    - **b.** As the voice for nursing internationally and as the developer of the ICNP, ICN is aware of the need to collaborate with IHTSDO to assure nursing domain content is available to nurses in IHTSDO member countries
      - **(1)** In 2010, ICN announced a collaborative agreement with the IHTSDO to advance terminology harmonization and foster interoperability in health information systems
    - **c.** ICN eHealth team members actively participate in the IHTSDO Nursing Special Interest Group with the aim of providing nurses with the resources needed to implement terminology to represent nursing practice in EHRs
      - **(1)** The current focus of this participation is to harmonize ICNP and SNOMED CT
      - **(2)** Results of these harmonization efforts include an equivalency table of ICNP nursing diagnosis and outcome concepts and SNOMED CT concepts
      - **(3)** This table is available for download from the ICN Web site
      - **(4)** The equivalency table is an early product of the ICN-IHTSDO collaboration
      - **(5)** Nurses are invited to join ICN and the IHTSDO Nursing Special Interest Group in this effort to advance the use of nursing terminologies in practice, administration, education, and research

11. **International Society for Telemedicine and eHealth (ISfTeH)**
    - **a.** The ISfTeH is a nonprofit organization with close ties to WHO and ICN, as well as other international organizations
        - **(1)** Its mission is to facilitate the international dissemination of knowledge and experience, as well as to support developing countries in the fields of telemedicine and eHealth
        - **(2)** ISfTeH is primarily an umbrella organization for national telemedicine and eHealth organizations and for individuals and academic centers working to integrate telehealth strategies and applications in healthcare
        - **(3)** It promotes and supports telemedicine and eHealth activities worldwide, supports developing countries in the field of telemedicine and eHealth, and assists the start-up of new national organizations
        - **(4)** The ISfTeH offers a variety of membership categories, including one for nurses
    - **b.** The ISfTeH Telenursing Working Group is open to all interested nurses and other healthcare providers
        - **(1)** Its mission is to provide a forum for exchange of knowledge and experiences of nurses and others who are working with or supporting nurses' use of eHealth applications
        - **(2)** The objective of the ISfTeH Telenursing Working Group is to support technology, business, and professional actions for telehealth nursing
        - **(3)** These actions include
            - **i.** Advocating for increased use and evaluation of telehealth services by nurses
            - **ii.** Stimulating innovative ideas and promoting initiatives for further development of eHealth
            - **iii.** Supporting interdisciplinary telehealth collaboration for improved healthcare delivery and outcomes
            - **iv.** Advancing nurses' knowledge and skills in telehealth through dissemination of research findings, education programs, and practice guidelines; and advocating for the ethical use of telehealth services
        - **(4)** Nurses from around the world are active participants in the annual ISfTeH conference, Med-e-Tel, describing their work and research in eHealth, telehealth, and nursing
12. **Healthcare Information and Management Systems Society (HIMSS)**
    - **a.** HIMSS is a global, not-for-profit organization focused on better health through ICT
        - **(1)** HIMSS leads collaboratives and conferences to promote the positive use of ICT in healthcare
        - **(2)** The HIMSS conferences in the United States, Europe, and Asia showcase exhibitors that represent commercial and noncommercial interests in the health ICT industry
        - **(3)** In 2003, the HIMSS Nursing Informatics Community was founded in response to the increased recognition of the role of the nurses in health informatics
        - **(4)** This new HIMSS community was intended to reach out to all nurses and promote involvement of those working in nursing informatics
        - **(5)** The HIMSS Nursing Informatics Community provides domain expertise, leadership, and guidance to the organizations' activities, initiatives, and collaborations with the global nursing informatics and eHealth communities
        - **(6)** Nurses are invited to become members of HIMSS and the nursing informatics community
13. **Health Level Seven International (HL7)**
    - **a.** HL7 is a not-for-profit, standards development organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery, and evaluation of health services
        - **(1)** "Level Seven" refers to the seventh level of the ISO seven-layer communications model for Open Systems Interconnection (OSI) at the application level
        - **(2)** The vision of HL7 is to create the best and most widely used standards in healthcare in order to improve care delivery, optimize workflow, reduce ambiguity, and enhance knowledge transfer among all stakeholders, including healthcare providers, government agencies, the vendor community, fellow standards development organizations, and patients
14. **HL7 Nurses Group**
    - **a.** The HL7 Nurses Group was started in 2009 during an HL7 International Working Group meeting
        - **(1)** The goals of the HL7 Nurses Group are to explore how nurses can become more involved in the HL7 community, to exchange information, and to ensure that nursing practice and nurses are included in uses cases and criteria for the HL7 standards
        - **(2)** Nurses are invited to join the HL7 Nurses Group List Service and to become involved in the group's efforts

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Applications in Global eHealth and Informatics

1. **Overview**
    - **a.** With new technologies, the collection, storage, and transmission of health data and information are changing the methods by which healthcare is delivered
        - **(1)** Professional nurses are leaders in this dynamic revolution to advance eHealth worldwide for health promotion, disease prevention, illness or injury care, and supporting a comfortable death
        - **(2)** In this section, select applications for eHealth are discussed to provide an understanding of current nursing research, education, and practice in this area
        - **(3)** Specifically, examples of innovations in the advancement of the electronic health record and telehealth are described

2. **Electronic health record (EHR)**
   - **a.** The EHR is a longitudinal electronic record of patient health information generated by one or more encounters across care delivery setting
     - **(1)** Optimally, the EHR supports and enhances quality of care with content appropriate to the healthcare setting and processes that enable decision support, outcomes reporting, and ease of use
     - **(2)** As one of the major innovations in healthcare, the EHR has brought both challenges and hope for improved healthcare delivery systems and better health outcomes for people worldwide
   - **b.** The EHRs developed in Denmark, New Zealand, and Sweden have been described as exemplars for EHR development in other countries looking to adopt national EHR solutions
     - **(1)** These three countries possess an advantage, in that their health authorities have strongly supported and promoted standardization, interoperability, and information sharing among healthcare providers
   - **c.** The ability to document healthcare using standardized, interoperable system applications is recognized as essential to unleash the tremendous capacity offered by information sharing through the EHR
     - **(1)** Electronic capture, storage, and retrieval of comparable health data across providers, settings, and specialties are the basis for meaningful use of the EHR
     - **(2)** The development of the ICNP was based on understanding this need for a standardized, interoperable international nursing terminology
   - **d.** Recent initiatives by international groups of nursing informatics experts include the following efforts to promote resources and tools for interoperable systems
     - ICN: An international unifying framework for nursing terminology, ICNP, has great potential for describing nursing practice, facilitating care transitions, and using consistent and accurate data for decision-making and policy development. It is only through its use in the EHR that the potential of ICNP will be realized. In addition to commercial software vendors and healthcare organizations being early adopters, a number of countries have endorsed ICNP as a national standard for nursing. ICN is developing resources to facilitate implementation of ICNP, such as ICNP Catalogs. Catalogs are subsets of ICNP content for use with select populations or in nursing specialty areas. Some examples of partnerships to create ICNP Catalogs are listed here:
       - ◦ Clinical Care Classification (CCC): CCC is a nursing terminology representing nursing problems, interventions, and patient outcomes. In an effort to promote the use of nursing standards in the EHR, ICN partnered with SabaCare (developer of CCC) to harmonize nursing content and provide resources for nurses and EHR application developers. Finland has supported the national implementation of CCC. The ICNP-CCC catalog can facilitate reuse of these national data, as well as local data and information captured using CCC, at the international level
       - ◦ Community Nursing Data Set: The National Health Service (NHS) in Scotland has enabled community nursing teams to facilitate meeting the needs of people where they live and work. To maximize the healthcare records to enable person-centered, safe, and effective care and provide data for quality improvement, resource allocation, and workforce planning a minimum data set for community nursing was commissioned by the NHS. ICN and NHS in Scotland partnership facilitate the development of an ICN Catalog for community nursing that is available for nurses worldwide
       - ◦ Canadian-Health Outcomes for Better Information and Care (C-HOBIC): A suite of standardized clinical concepts that reflect nursing practice and are used to document and measure patient outcomes in EHRs was approved as a national standard by Canadian Health Infoway in 2012. Canadian Nurses Association (CAN), ICN, and IHTSDO work together to harmonize the concepts in C-HOBIC to help facilitating sharing data as in the EHR as patients transition across the various sectors of the health system
     - IHTSDO: For countries implementing SNOMED CT as an interdisciplinary terminology for healthcare, nurses need to be involved and engaged in assuring the representation of the nursing domain content. As noted earlier in this chapter, ICN is partnering with IHTSDO to facilitate the harmonization of ICNP and SNOMED CT concepts
     - WHO: With its worldwide influence, WHO has an opportunity to advance the reporting of health and illness globally through partnering with other professional organizations such as ICN in the achievement of standardization and interoperability. WHO-ICN collaborations have focused on harmonizing ICNP and ICF and on the development of an International Classification for Health Interventions (ICHI)
   - **e.** In additional to the potential of interoperable data and information, the EHR has the potential to change the relationship between provider and consumer

Teaching Tip

Imagine, as a nurse, that the clients you interact with in healthcare episodes, be they individuals, families, or communities can access their health data and information in real time electronically. As the EHR evolves, nurses will use this new technology to support the shift from a provider-centered health system to a consumer-centric model of healthcare. Various EHR applications will facilitate nurses' access to their patients and the patients' access to their health providers.

3. **Telehealth and mHealth in the eHealth environment**
   - **a.** Telehealth nursing extends the capability and reach of nurses and aims to improve access and quality, while managing healthcare costs
     - **(1)** While the use of technology changes the care delivery medium, and may necessitate new competencies, the nursing process and scope of practice are not significantly different in telenursing, whether in direct care nursing, education, or management

- **b.** From its establishment in 2009 to early 2014, about 300 members representing 64 countries have joined the ICN Telenursing Network
  - **(1)** The membership represents nurses interested in or working in many different capacities
  - **(2)** These include
    - **i.** Clinical practice (e.g., cardiovascular disease, pulmonary disease, intensive care, pediatric care, women's health and mental health), education (both educators and nurses advancing their education)
    - **ii.** Video-conferencing
    - **iii.** Tele-simulation
    - **iv.** Tele-counseling
    - **v.** Tele-triage
    - **vi.** Telenursing standards and competencies development
    - **vii.** Rural and remote telehealth
    - **viii.** Community health
    - **ix.** Industrial nursing
- **c.** Research reports involving eHealth applications can be found online and in print in almost all major journals related to healthcare and there is an increasing number of journals dedicated to telehealth research
  - **(1)** Unfortunately, not all publications list researchers' credentials, making it somewhat difficult to identify nurse-led research, but careful scrutiny reveals nurses' involvement in almost every environment of telehealth care delivery and research
- **d.** The wide range of research known to be led by nurses or to include nurses among the research team reflects nursing's impact throughout healthcare

Teaching Tip

Examples include studies of nurses themselves, nursing students, eICU, surgery, orthopedics, neurology, communicable diseases, non-communicable diseases, and mental health. Nurses are essential in building the body of knowledge about telehealth applications and technologies in furthering healthcare access, quality, and cost management.

Teaching Tip

Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Global Trends Supported by and Driving eHealth

1. **Overview**
   - **a.** eHealth has influenced many changes in the health arena internationally
     - **(1)** Three trends are discussed in this section: nurse care coordination, self-management, and health equity
2. **Nurse care coordination**
   - **a.** Global trends are beginning to reflect the change in expectations of partnership among healthcare providers across various healthcare settings, the individual patient, family members, and community groups
     - **(1)** Based on evidence, policy makers at the local, national, and international levels are recognizing the importance of continuity of care to decrease costs and increase quality
     - **(2)** With the increase in multiple health providers involved in one person's care and population mobility of both patients and health providers, countries are looking for solutions to reduce fragmentation of healthcare
     - **(3)** In addition to increasing communication by using the EHR, another proposed solution is care coordination programs
   - **b.** The American Academy of Nursing offered a set of recommendations to guide the development of the EHR to support care coordination across the continuum of health service delivery
     - **(1)** Along with the infrastructure needs, nurses' participation in identifying data and information needs for care coordination across settings and services will be essential
     - **(2)** One committee in Integrating the Healthcare Enterprise (IHE), a nonprofit initiative to engage healthcare professionals and industry to improve interoperability, is focused on patient care coordination
     - **(3)** IHE has published a patient care coordination technical framework for testing that includes a patient plan of care profile based on data elements of the nursing process
   - **c.** Huber and colleagues have promoted the work of IHE in coordination with their research in eNursing Summary profiles to advance exchange of nursing data and promote care coordination
     - **(1)** Researchers in Germany and Finland have developed candidate models for an eNursing Summary
     - **(2)** Both models include components of the nursing process
     - **(3)** Understanding that context and environment impact local and nation implementation of standards, the question arises on whether there could be a universal concept or shared model of an international eNursing Summary
     - **(4)** In an effort to engage more nurses around the globe, the researchers have proposed ongoing collaboration with IHE, ICN, and IMIA-NI to continue work toward an international eNursing Summary framework
   - **d.** Clearly, care coordination is centered on the patient
     - **(1)** A major focus of care coordination is to empower the patient as a partner in care
     - **(2)** Promoting self-management has become an important component of nursing practice, especially in care of our aging population, persons with chronic illness, and those with known risks for health problems
3. **Self-management**
   - **a.** Concepts such as person-centered care, person-centered medicine, patient-centered care, and personalized medicine are topics in today's healthcare literature in large part due to the recognition that the digital revolution has encouraged

people to become more involved with their own health and wellness

   - **(1)** An outcome of this involvement is the movement toward self-management, often supplemented with ICT in the person's home or other environments

- **b.** Literacy is one of many identified components included in the Individual and Family Self-Management Theory
   - **(1)** Further discussion about health literacy and digital literacy in the context of nursing and eHealth follow

4. Health literacy

- **a.** The Health Promotion Glossary of the WHO states that "Health literacy represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways to promote and maintain good health"
   - **(1)** The word "use" distinguishes health literacy from health knowledge, wherein a health consumer may know a lot about health promotion and disease prevention, but is either unwilling or unable to translate this knowledge into action
- **b.** Baur purported that, of all the clinical disciplines, "nursing has a unique relationship to health literacy because nurses are responsible for the majority of patient, caregiver, and community health education and communication"
   - **(1)** Speros added that nurses are invested in increasing healthcare consumers' health literacy whose positive consequences include improved self-reported health status, lower healthcare costs, increased health knowledge, shorter hospitalizations, and decreased use of health services
   - **(2)** Negative consequences of low health literacy include increased healthcare costs, poor adherence, medical and medication treatment errors, and "lack of skills needed to successfully negotiate the healthcare system"
- **c.** A review of the literature revealed few publications by nurse researchers and practitioners about interventions to improve patients' health literacy
   - **(1)** One study of a nurse-delivered, though not nurse-developed, health literacy intervention showed an increase in adherence to antiretroviral medications among patients with limited reading ability
   - **(2)** A second study of a nurse-tailored health literacy intervention regarding HIV medication adherence among African Americans resulted in no statistically significant difference between the control and intervention groups
   - **(3)** Despite the lack of published intervention studies, the relationship between patients' and families' access to health information and their engaged in their own care has been supported
   - **(4)** The importance of health literacy as a factor in promoting self-management will become more important with implementation of EHR and telehealth
   - **(5)** Nurses can take a lead in examining interventions in promoting health literacy across their multiple specialty areas
- **d.** Schaefer concluded that health literacy interventions can be categorized into various types by mode of delivery, which include personal contact, computer, and written materials, as well as any combination of these types
   - **(1)** Further, Speros suggested the following strategies to promote health literacy: creating a shame-free environment, using clear and purposeful communication, communicating in a patient-centered manner, reinforcing the spoken word, and verifying understanding

5. Digital literacy

- **a.** The Internet has become one of the most ubiquitous sources of healthcare information
   - **(1)** Digital literacy, therefore, has become an important component of health literacy for patients and healthcare providers alike
   - **(2)** Gilster defines digital literacy as "the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers"
- **b.** The Institute of Medicine, in their report recommendations from their "Future of Nursing: Leading Change, Advancing Health" stressed the importance of digital literacy for nurses and other healthcare providers
   - **(1)** Specifically, the IOM recommended healthcare organizations engage nurses and other front-line healthcare workers in the design, development, purchase, implementation, and evaluation of medical devices and EHR software
   - **(2)** Early involvement allows nurses to ensure that new technology enhances, rather than hinders, their workflow and that nursing-based content is included in documentation software
- **c.** Digital literacy has the potential to enhance many aspects of human existence
   - **(1)** According to the Bill and Melinda Gates Foundation access to information and knowledge is a great equalizer
   - **(2)** It enriches lives, informs choices, and prepares people for meaningful employment and contribution to their communities
   - **(3)** As part of the Gates funded initiative, a number of countries have benefited
   - **(4)** In Chile, a national digital literacy campaign trained hundreds of thousands of people in basic technology skills, largely via a network of more than 300 public libraries
   - **(5)** In Mexico, public libraries provide the only Internet access for nearly two-thirds of rural communities
   - **(6)** In rural Botswana, public libraries serve as small business owners' offices, helping people make their businesses more sophisticated and competitive
   - **(7)** In Ukraine, one community has used library Internet access to collect information about farming techniques, fundamentally changing the way they grow tomatoes and substantially increasing their crop quality and yield
- **d.** The European Computer Driving License (ECDL) Foundation, which is known as the International Computer Driving License (ICDL) Foundation outside of Europe, recognizes

the worldwide importance of developing a digitally literate society

(1) However, digital literacy is not solely a matter of supplying hardware and software; it is also necessary to ensure that people have the requisite skills to use the technology effectively

(2) In acknowledgment of this fact, a number of governments, education authorities, and not-for-profit organizations have launched initiatives aimed at raising the levels of digital literacy through training and certification

(3) With health information systems expected to become increasingly important in enabling national health systems operate efficiently, the ECDL Health Information Systems Usage certification was designed for both health professionals and auxiliary staff, and has been introduced in the Middle East, the United Kingdom, Finland, Portugal, Italy, and Zambia

(4) Professionals in the Pacific Islands are also benefitting from international digital skills training and certification, thanks to a new agreement with ICDL Asia

e. Another effort to improve digital literacy is the Non-Roman Script Initiative (NRSI)

(1) The NRSI mission is to reduce barriers to using computers among language communities that do not use Roman script (e.g., Arabic, Khmer, and Chinese)

(2) NRSI's goal is to provide assistance, research, and development for SIL International and its partners to support the use of non-Roman and complex scripts in language development

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

Promoting Health Equity through eHealth

1. Overview

a. Electronic commerce, commonly known as e-commerce, is the production, distribution, marketing, sale, or delivery of goods and services over the Internet or other electronic networks

(1) The increased amount and velocity of exchanging products and information available are creating a revolution in the way that business is conducted

(2) Access to the required technology to participate in exchange of products and information is an issue for eHealth

(3) The population of the African continent is approximately 800 million, but only 4 million of them use e-mail (compared to 513 million globally) and of these, 2 million are based in South Africa

(4) Mobile broadband subscriptions across the world are increasing, while many people do not yet own a mobile phone

b. In a 2014 position statement, ICN (2014) recognized that wealth influences readiness for ICT, with a clear demarcation between high-income countries and low-income countries

(1) Nurses can demonstrate leadership in promoting policies at the global, regional, national, and local levels to provide the infrastructure and skills needed to make ICT a reality across all members of society, including both those receiving and those providing healthcare

c. Nurses work with individuals, families, and communities to promote health, to prevent illness, to restore health, and to alleviate suffering

(1) eHealth has the potential to transform both nursing and healthcare

(2) eHealth is not just about the ICT, it is about using technology to collaborate, to communicate, and to advocate

(3) At the same time, unless there is equity in access to technology sources of health information and knowledge, eHealth could serve to disenfranchise a large proportion of the world's population and a significant number of nurses and health providers in poor, disadvantaged areas of the world

Teaching Tip
Summarize and review the content before beginning the next section. Provide this as an opportunity for the students to ask questions.

SUMMARY

Teaching Tip
Ask the students to identify what was the most important thing they learned in the chapter.

Teaching Tip
Review the chapter objectives

- Describe international organizations and their roles in advancing global eHealth and informatics
- Discuss nursing's contributions to international health informatics initiatives
- Discuss applications of eHealth in the global health environment
- Explore current issues and trends for their effects on global eHealth and nursing

Teaching Tip
Ask the students to define the keywords

- eHealth
- Global health
- mHealth
- Nursing informatics
- Telehealth nursing

CHAPTER REVIEW QUESTIONS

Question 50.1: What is the name of the international organization with the first and widest reaching to nursing health professionals?

- **a.** The American Nurses Association
- **b.** The International Council of Nurses (ICN)
- **c.** The International Medical Informatics Association
- **d.** None of the above

Question 50.2: Name the three components of the ICN eHealth Program.

- **a.** The INCP—the International Classification for Nursing Practice, the ICN Telenursing Network, and the Connecting Nurses initiative
- **b.** Reporting to the WHO, the United Nations, and the World Health Professions Alliance
- **c.** Reporting to the WHO, the World Health Assembly, and the International Medical Informatics Association
- **d.** None of the above

Question 50.3: Nursing-specific nursing diagnoses and nursing actions in terminological systems are included in which international standard?

- **a.** The International Standard Organization's (ISO) Standard 18104 (Health Informatics, Categorical structures)
- **b.** ISO Technical Committee (TC) 215 for Healthcare Informatics has as its scope the standardization of health information resources, including nursing informatics and telehealth nursing
- **c.** a and b
- **d.** None of the above

Question 50.4: The name of the international not-for-profit organization that develops and maintains SNOMED-CT is?

- **a.** The WHO
- **b.** The ICNP
- **c.** The IMIA
- **d.** The International Health Terminology Standards Development Organization (HITSDO)

Question 50.5: What is the name of the international organization that is nursing's voice in IHTSDO and the WHO?

- **a.** The IMIA, Nursing Working Group
- **b.** The ICN eHealth team members
- **c.** The International Standards Organization
- **d.** None of the above represent nursing

Question 50.6: True or False. The ISfTeH Telenursing Working Group is to support technology, business, and professional actions for telehealth nursing.

Question 50.7: What three countries serve as exemplars for EHR development internationally?

- **a.** The United States, France, and Italy
- **b.** Denmark, New Zealand, and Sweden
- **c.** Denmark, the United States, and Australia
- **d.** New Zealand, Australia, and the United States

Question 50.8: What three attributes do these countries possess that provides their advantage in EHRs.

- **a.** Standards, interoperability, and information sharing among health professionals
- **b.** Standards, resources to support the programs, and a critical mass of health IT professionals to implement them
- **c.** Interoperability, information sharing, and monetary resources
- **d.** A critical mass who believe in standards, financial resources, and quality vendors

Question 50.9: In an effort to promote the use of nursing standards in the EHR, INC partnered with which nursing terminology to harmonize nursing content for nurses and EHR application developers?

- **a.** SabaCare, CCC
- **b.** SNOMED CT
- **c.** NIC, NAC, NANDA
- **d.** The Omaha System

Question 50.10: ICN and IHTSDO work together to harmonize the concepts of which project for patient outcomes?

- **a.** SabaCare, CCC
- **b.** NIC, NAC, NANDA
- **c.** The Omaha System
- **d.** Health Outcomes for Better Information and Care from Canada—C-HOBIC

ANSWERS AND EXPLANATIONS

Question 50.1: (b) Founded in 1899, the International Council of Nurses (ICN) is the world's first and widest reaching international organization for health professionals.

Question 50.2: (a) The three components of the ICN eHealth Program are: the INCP—the International Classification for Nursing Practice, the ICN Telenursing Network, and the Connecting Nurses initiative.

Question 50.3: (c) a and b. The International Standard Organization's (ISO) Standard 18104 (Health Informatics, Categorical structures). ISO TC 215 is also the body that is responsible for new standards that involve nursing informatics and telehealth nursing in the areas of terminology, telehealth, messaging, and a range of other topics related to eHealth.

Question 50.4: (d) The International Health Terminology Standards Development Organization (IHTSDO) is a not-for-profit organization based in Denmark. Its main purpose is to develop and maintain the Systematized Nomenclature of Medicine—Clinical Terms (SNOMED CT).

Question 50.5: (b) ICN eHealth team members actively participate in the IHTSDO Nursing Special Interest Group with the aim of providing nurses with the resources needed to implement terminology to represent nursing practice in EHRs.

The current focus of this participation is to harmonize ICNP and SNOMED CT.

Question 50.6: True. The ISfTeH Telenursing Working Group is to support technology, business, and professional actions for telehealth nursing. Nurses participate in advancing nurses' knowledge and skills in telehealth through dissemination of research findings, education programs, and practice guidelines; and advocating for the ethical use of telehealth services.

Question 50.7: (b) The EHRs developed in Denmark, New Zealand, and Sweden have been described as exemplars for EHR development in other countries looking to adopt national EHR solutions (Gray, Bowden, Johansen, & Koch, 2011).

Question 50.8: (a) These three countries possess an advantage, in that their health authorities have strongly supported and promoted standardization, interoperability, and information sharing among healthcare providers.

Question 50.9: (a) SabaCare CCC. In an effort to promote the use of nursing standards in the EHR, ICN partnered with SabaCare (developer of CCC) to harmonize nursing content and provide resources for nurses and EHR application developers.

Question 50.10: (d) Canadian-Health Outcomes for Better Information and Care (C-HOBIC): A suite of standardized clinical concepts that reflect nursing practice and are used to document and measure patient outcomes in EHRs was approved as a national standard by Canadian Health Infoway in 2012. Canadian Nurses Association (CAN), ICN, and IHTSDO work together to harmonize the concepts in C-HOBIC to help facilitating sharing data as in the EHR as patients transition across the various sectors of the health system.

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